ATLAS OF Musculoskeletal Ultrasound Anatomy

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Preface – technology introduction

The images in the current text were achieved using an ATL HDI 5000 SonoCT ultrasound system (Advanced Technology Laboratories, Bothwell, WA) coupled with an L12–5 MHz footprint linear array transducer. A stand-off pad was not used, but liberal amounts of coupling gel was applied.

Most of the images displayed were obtained using ATL's patented SonoCT real-time compound imaging technology. This technology is distinct from conventional ultrasound in that it obtains images from multiple lines of sight. In real-time compounding, ultrasound beams are steered from up to nine lines of sight and are combined into a single image at real-time frame rates. This allows all structures to be scanned at a plane that is at or close to 90° to one or more of the scan lines. It is distinct from other compounding methods, in that it uses computed transmit-and-receive functions to form a compound image in real time. This technology can dramatically suppress or eliminate many routine problems that degrade ultrasound images, such as noise, speckle, clutter and image artefacts. In addition, contrast resolution is enhanced improving diagnostic confidence.

Recently, ATL have introduced SonoCT Imaging achieving a breakthrough in panoramic image quality. ATL uses patented pattern recognition technology, instead of matching pixels along the edge of an image to generate a panoramic appearance. Panoramic SonoCT relies on processing tissue patterns captured from a region of interest. This real-time pattern recognition method makes it easier and faster to perform panoramic scanning because it is less dependent on the user maintaining a steady and smooth sweep. It also enables the user to easily reverse direction without restarting a panoramic scan.

Principles and pitfalls of musculoskeletal ultrasound

High resolution – best results are obtained using a high frequency linear probe on a matched ultrasound system. Power Doppler is often helpful for pathological diagnosis as well in the identification of normal anatomy.

Anisotropy – this phenomenon produces focal areas of hypo-echogenicity when the probe is not at 90 degrees to the linear structure being imaged. This is particularly noticeable when imaging tendons resulting in simulation of hypo-echoic pathological lesions within the tendon. The sonographer can compensate for this by maintaining the 90-degrees angle or by using compound imaging.

Anatomy – knowledge of the relevant anatomy is essential for accurate diagnosis and location of disease.

Symmetry – The sonographer can often compare anatomical areas for symmetry helping to diagnose subtle echographic changes.

Dynamic – ultrasound successfully lends itself to scanning whilst moving the relevant anatomy, either passive or resistive. This can help to demonstrate abnormalities which may be accentuated by movement.

Palpation – the sonographer has the opportunity to palpate the abnormality or anatomy linking the imaging directly with the symptomatology, in a manner not possible with other types of cross-sectional imaging.

Echogenicity of tissues

Echogenicity may vary somewhat with different ultrasound probe frequencies and machine set-up. This section describes these tissues using the common musculoskeletal presets and frequency 12–5 MHz. Surrounding tissue also influences echogenicity due to beam attenuation.

Fat – pure fat is hypo-echoic/transonic but the echogenicity varies in different anatomy and pathology. Fatty tumours such as lipomas contain areas of connective tissue creating the characteristic linear hyper-echoic lines parallel to the skin. Other fatty areas may vary in echogenicity depending on their structure and surrounding tissue.

Muscle – muscle fibres are hypo-echoic separated by hyper-echoic interfaces. Hyper-echoic fascia surrounds each muscle belly delineating the muscle groups.

Fascia – hyper-echoic thin, well-marginated soft tissue boundaries.

Tendon – the hyper-echoic tendon consists of interdigitated parallel fibres running in the long axis of the tendon. The tendon sheath is hyper-echoic separated from the tendon by a thin hypo-echoic area.

Paratenon – some tendons do not have a true tendon sheath but are surrounded by an hyper-echoic boundary, the para-tenon. For example, the tendo-achilles.

Ligament – hyper-echoic, similar to tendons. Fibrillar pattern may vary in multilayered ligaments.

Synovium/Capsule – these structures around joints are not usually separately distinguishable on ultrasound, both appearing hypo-echoic and similar to joint fluid.

Hyaline cartilage – hypo-echoic/transonic cartilage is seen against highly reflective cortical bone.

Costal cartilage – hypo-echoic, well defined. Well marginated from the hyper-echoic anterior rib end. The echogenicity varies depending on how much calcification it contains.

Fibrocartilage – hyper-echoic, usually triangular-shaped cartilage often with internal specular echoes, for example, the menisci.

Bone/Periosteum – these are indistinguishable in normal bone. Highly reflective hyper-echoic linear/curvi-linear line with acoustic shadowing.

Pleura – hyper-echoic parietal pleura is usually seen in the normal intercostal area. Aerated lung deep to this.

Air/gas – this is also highly reflective and creates characteristic "comet tail" artefacts. Small gas bubbles in tissue may give small hyper-echoic foci whilst aerated lung is diffusely hyper-echoic with comet tails.

Nerve – hypo-echoic linear nerve bundles separated by hyper-echoic interfaces, appearances similar to tendons.

Chest

Supraclavicular fossa 2
Infraclavicular fossa 8
Sternoclavicular joint 10
Chest wall 12
Axilla 22

Supraclavicular fossa

(Figures 1–9)

This is an ill-defined area at the inferior aspect of the posterior triangle of the neck. It is bounded by the clavicle inferiorly, sternomastoid muscle medially and trapezius postero-laterally. The floor is muscular, comprising levator scapulae, splenius and the three scalene muscles.

Contents

- Accessory nerve
- Omohyoid
- External jugular vein
- Lymph nodes
- Subclavian artery
- Brachial plexus

Scalene muscles

- *Scalenus anterior*
  - Origin: anterior tubercles cervical vertebrae 3–6.
  - Insertion: scalene tubercle first rib.
- *Scalenus medius*
  - Origin: posterior tubercles cervical vertebrae 2–7.
  - Insertion: first rib, posterior to subclavian groove.
- *Scalenus posterior*
  - Origin: as part of scalenus medius.
  - Insertion: second rib.

Notes

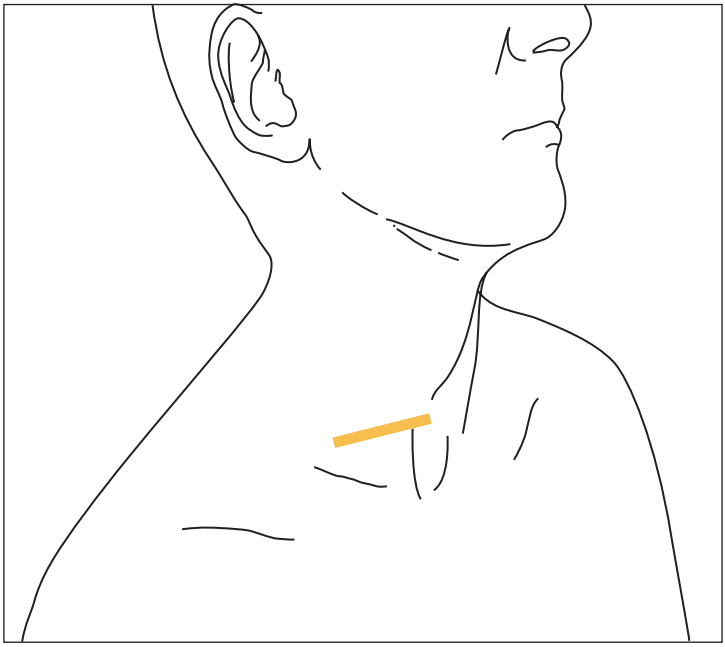

FIG. 1 TS, anterior supraclavicular fossa, probe over sternomastoid

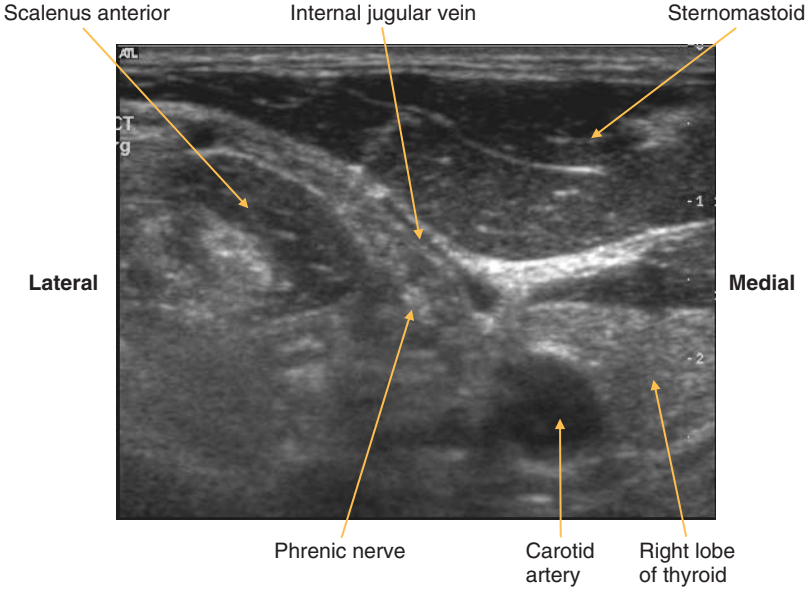

FIG. 2 TS, anterior supraclavicular fossa

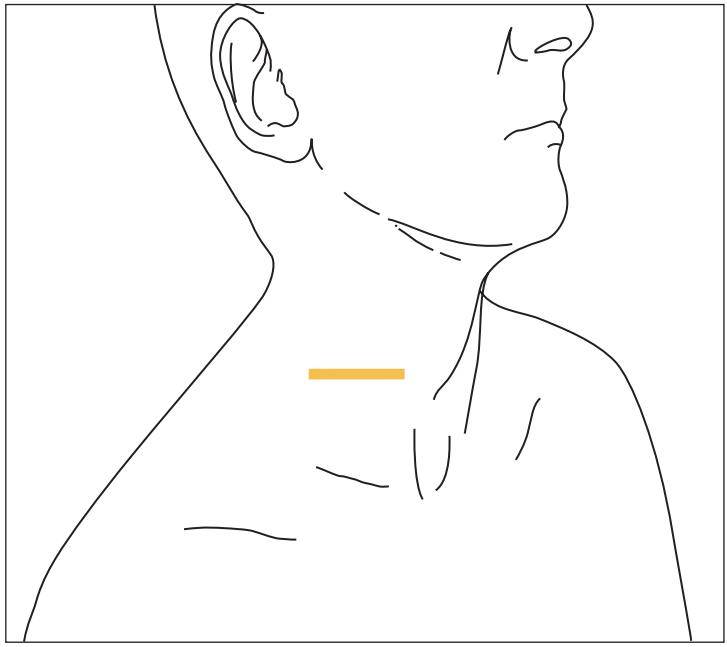

FIG. 3 TS, supraclavicular fossa, probe on posterior sternomastoid

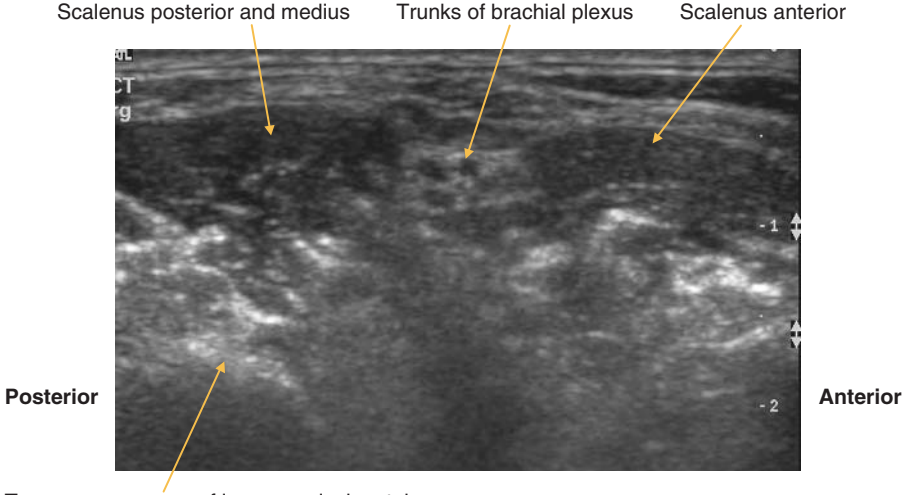

FIG. 4 TS, supraclavicular fossa

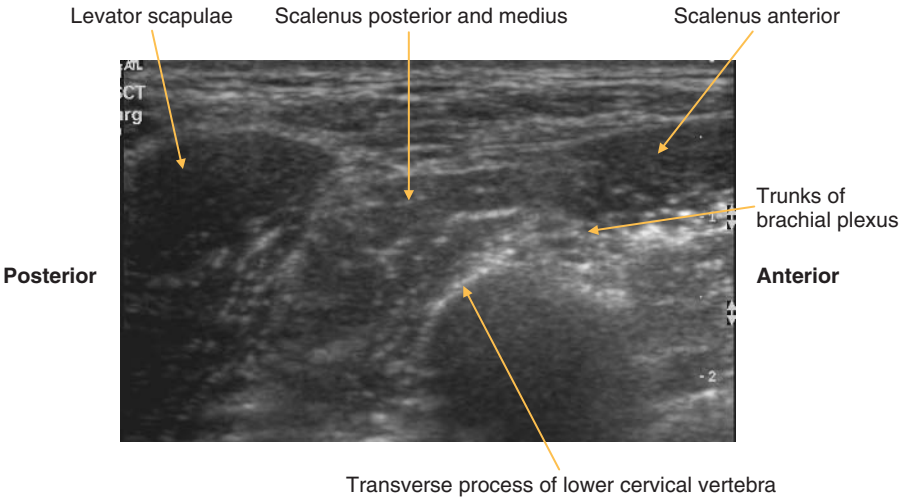

FIG. 5 TS, posterior supraclavicular fossa

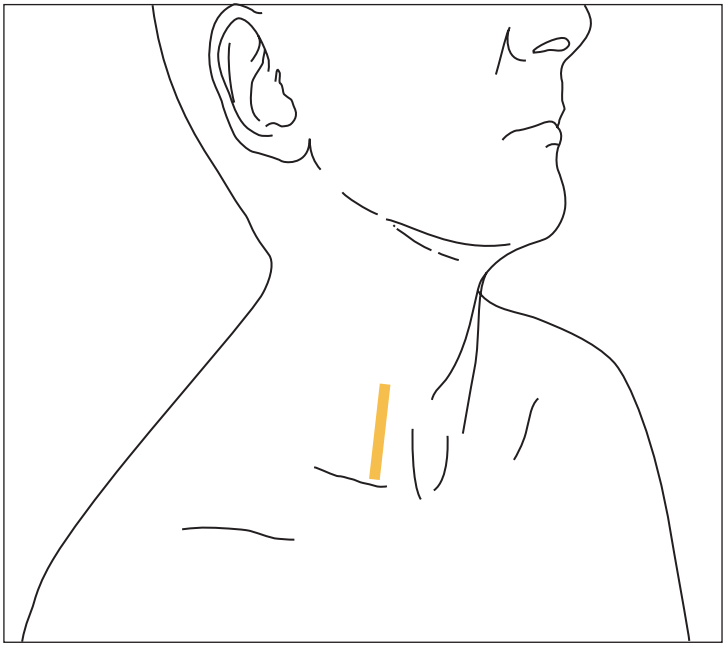

FIG. 6 LS, supraclavicular fossa, probe over posterior sternomastoid

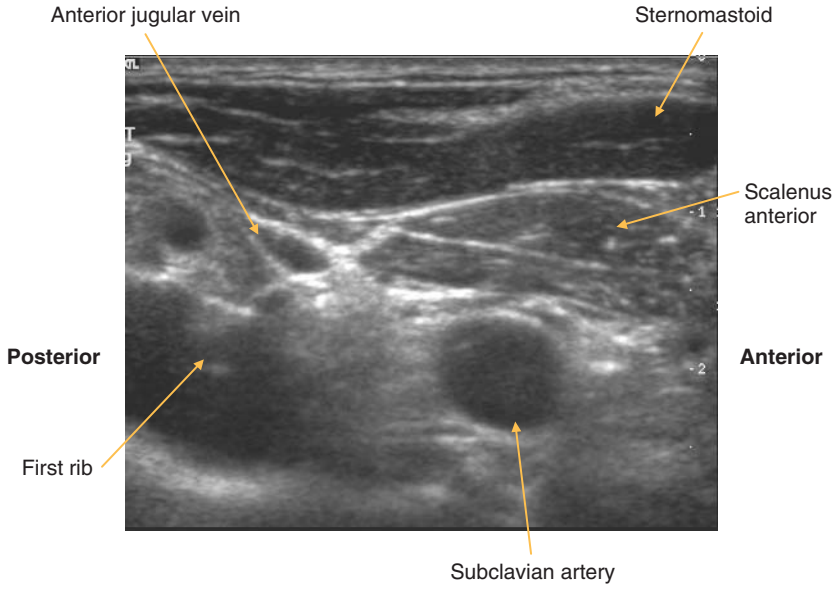

FIG. 7 LS, oblique supraclavicular fossa

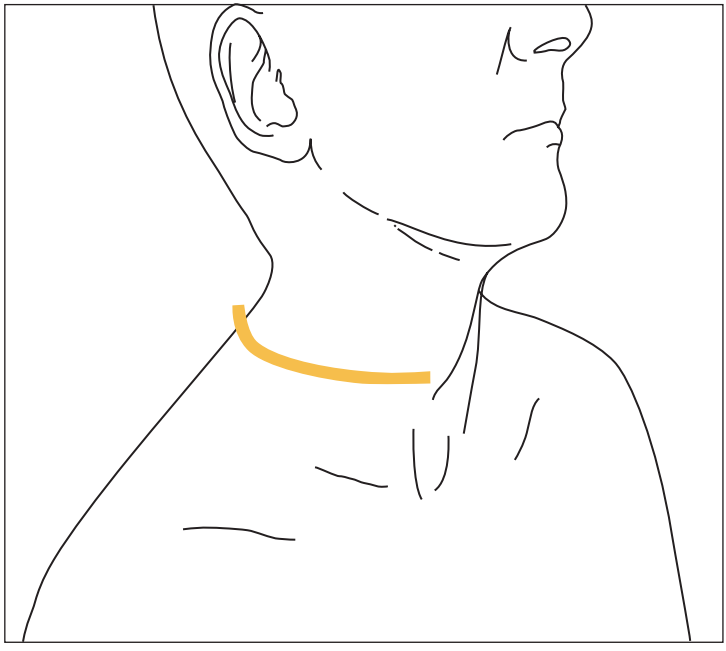

FIG. 8 TS panorama, supraclavicular fossa

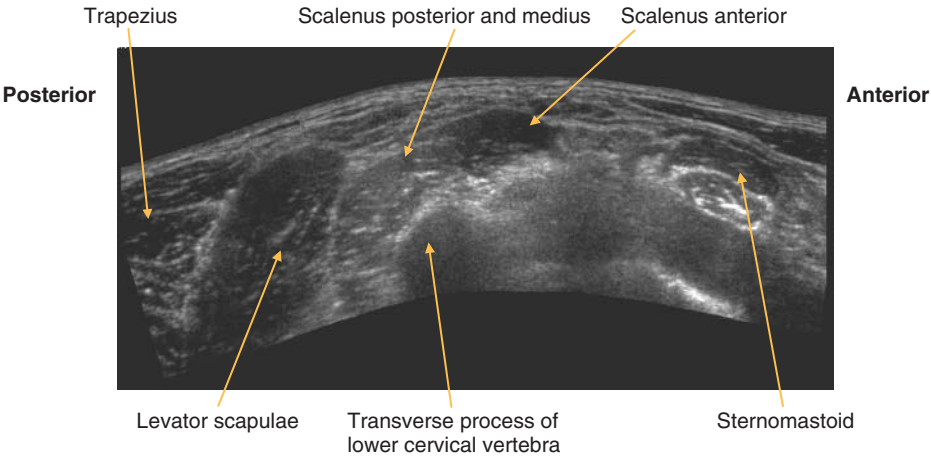

FIG. 9 TS panorama, supraclavicular fossa

Infraclavicular fossa

(Figures 10 and 11)

Notes

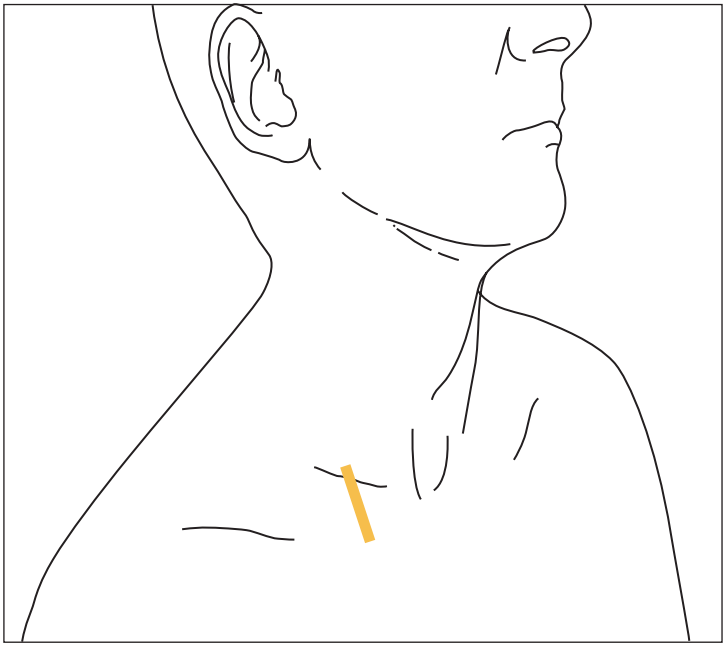

FIG. 10 LS, probe inferior to the clavicle

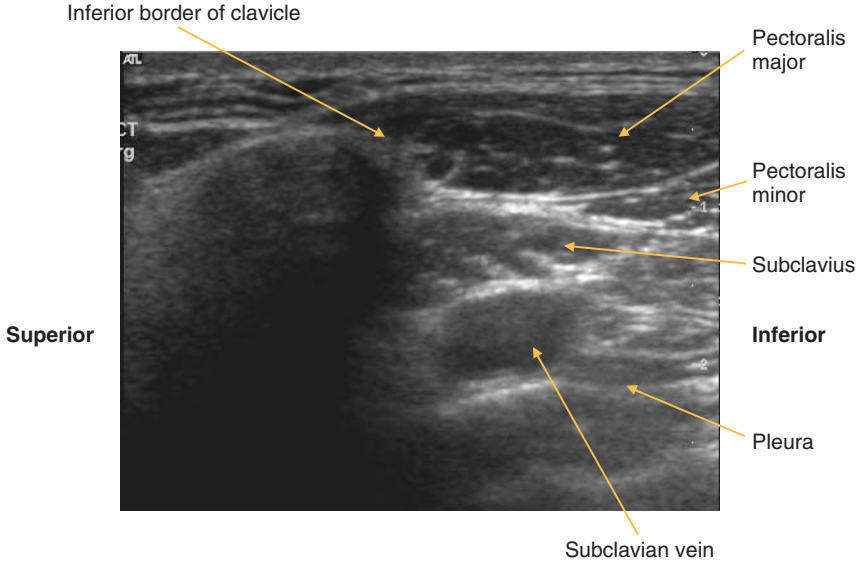

FIG. 11 LS, infraclavicular fossa

Sternoclavicular joint

(Figures 12 and 13)

This is an atypical synovial joint, like the acromioclavicular joint, as the articular surfaces are covered with fibrocartilage. The medial end of the clavicle articulates with the manubrium and first costal cartilage. The capsule is thickened anteriorly and posteriorly to form the sternoclavicular ligaments. Further ligaments attach to the first rib and contralateral clavicle.

Notes

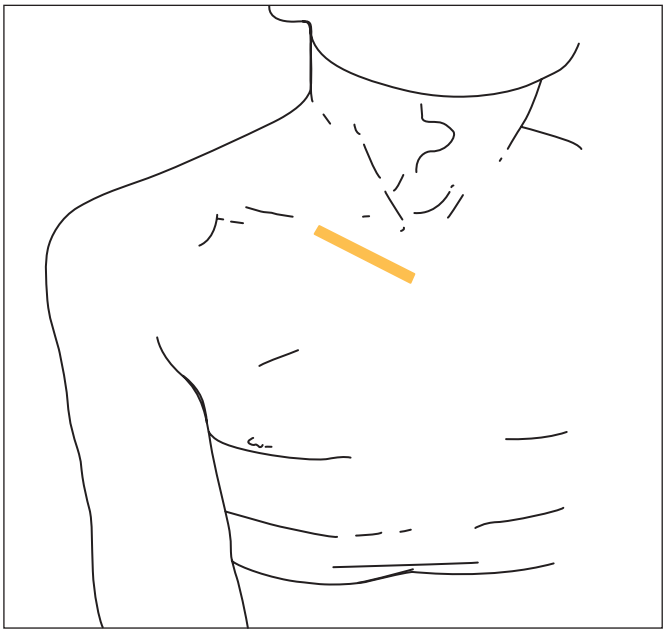

FIG. 12 Probe longitudinal to joint, angled at 45 degrees to midline

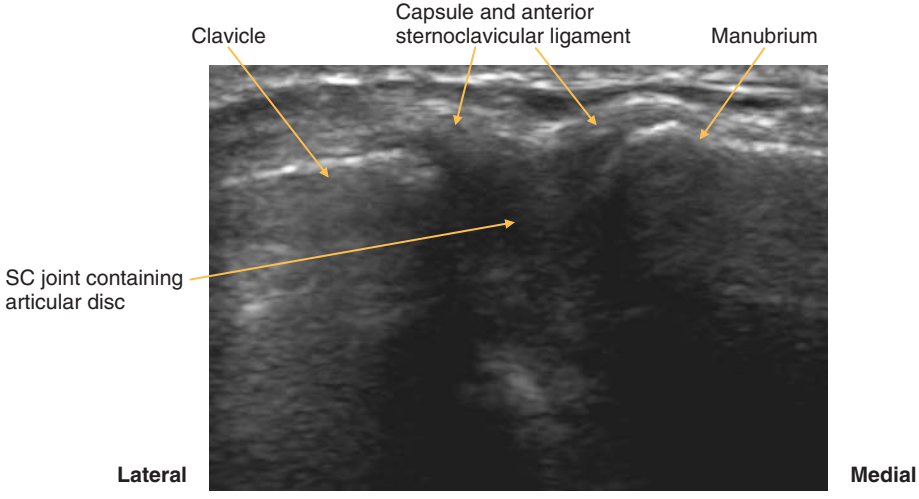

FIG. 13 LS, sternoclavicular joint

Chest wall

Anterior

The thoracic wall muscles lie in three layers analogous to those in the abdomen, but separated by ribs. The outer two layers (external and internal intercostal) are usually visible in a rib space, deep to which can be seen the pleural space and lung. The neurovascular bundle lies deep to the second layer at the superior aspect of the intercostal space.

Ribs and costal cartilages

(Figures 14–17)

The anterior aspect of a rib articulates with a costal cartilage via a cartilaginous joint at which no movement is possible. The rib is deeply concave, and cartilage convex. The second to seventh costal cartilages articulate with the sternum via synovial joints. Calcification within costal cartilages is highly variable, and causes foci of hyper-echogenicity.

Notes

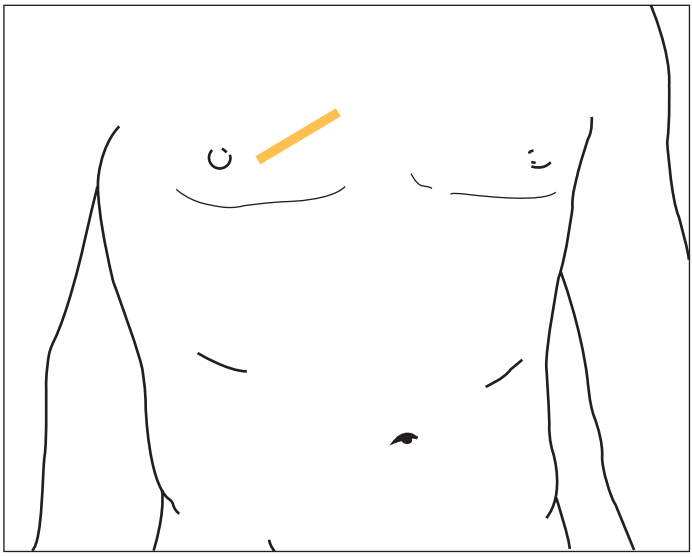

FIG. 14 Probe longitudinal to costal cartilage

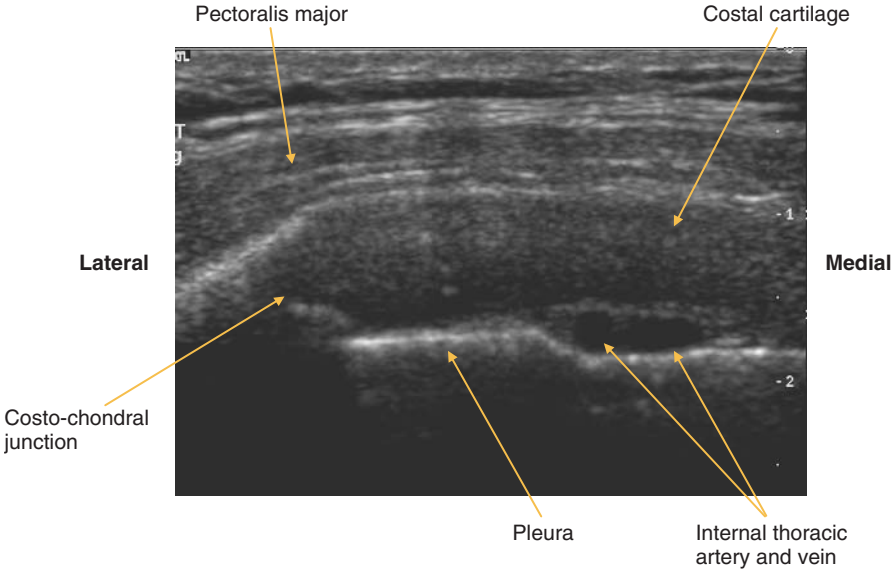

FIG. 15 LS, chest wall parasternal

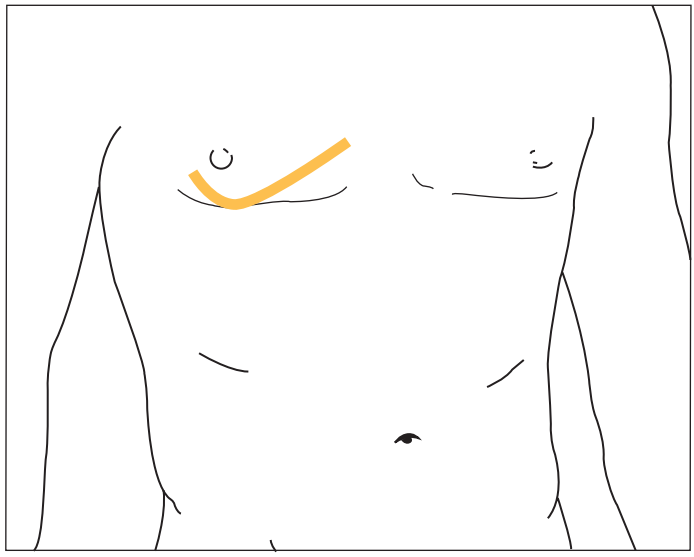

FIG. 16 LS panorama of rib and costal cartilage

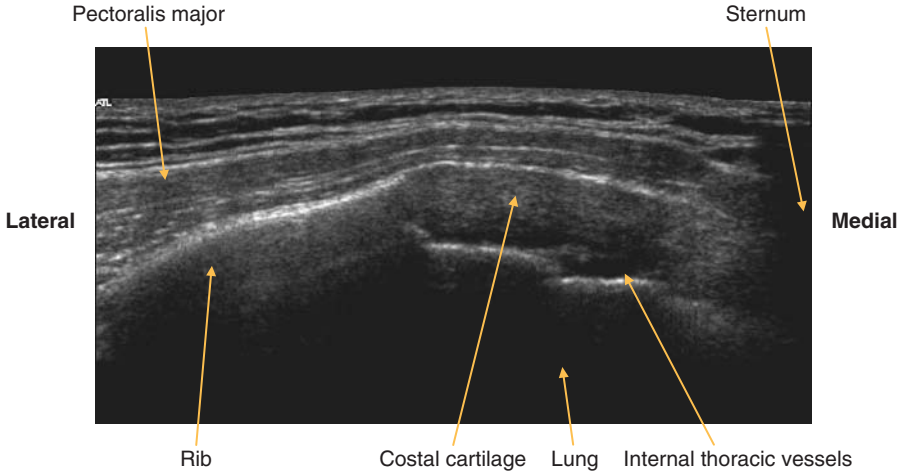

FIG. 17 Panorama, anterior chest wall

Lateral chest wall

(Figures 18 and 19)

External and internal intercostals

- Origin: lower border of superior rib.
- Insertion: upper border of inferior rib. Internal intercostals deep to external.

Serratus anterior

- Origin: upper eight ribs, overlying the lateral chest wall.
- Insertion: inferior angle and costal margin of the scapula. It forms the medial wall of the axilla.

Notes

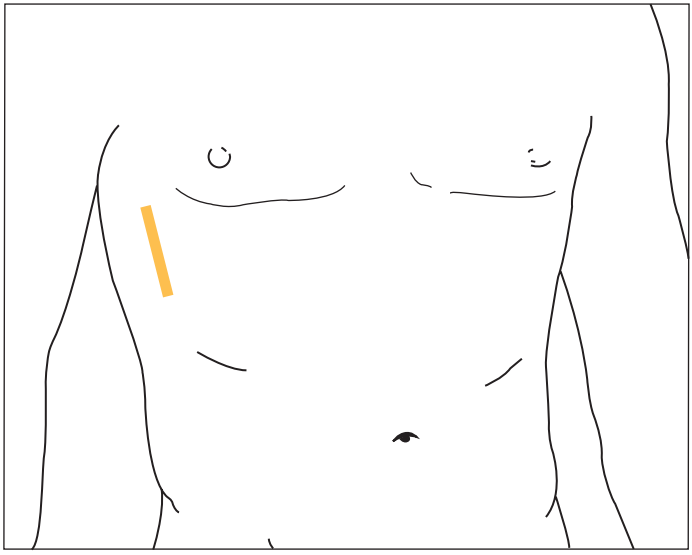

FIG. 18 TS, rib space on lateral aspect of chest

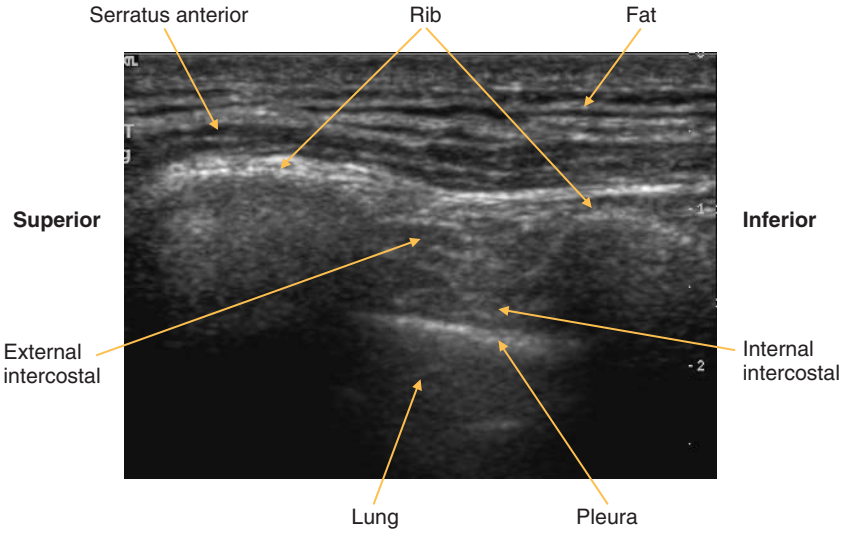

FIG. 19 TS of chest wall – intercostals

Posterior chest wall

(Figures 20–22)

Trapezius muscle covers the postero-medial aspect of the upper chest:

- Origin: from skull to the T12 vertebra in the midline.
- Insertion: clavicle, acromion and spine of the scapula.

Deep to trapezius are the muscles that extend from the vertebral column to the medial aspect of the scapula – levator scapulae superiorly and the rhomboids inferiorly. Inferiorly, trapezius covers the superior aspect of latissimus dorsi. The erector spinae muscles are deep to the rhomboids.

- Levator scapulae
  - Origin: posterior tubercles of transverse processes of upper four cervical vertebrae.
  - insertion: superior angle, medial border of scapula.
- Rhomboids
  - Origin: lower part of ligamentum nuchae and spines of cervical and upper four thoracic vertebrae.
  - Insertion: medial border scapula, major inferiorly, and minor between levator scapulae and major.
- Latissimus dorsi
  - Origin: spines of lower six thoracic vertebrae, lumbar fascia, lower four ribs and posterior iliac crest.
  - Insertion: floor of bicipital groove of humerus.

Notes

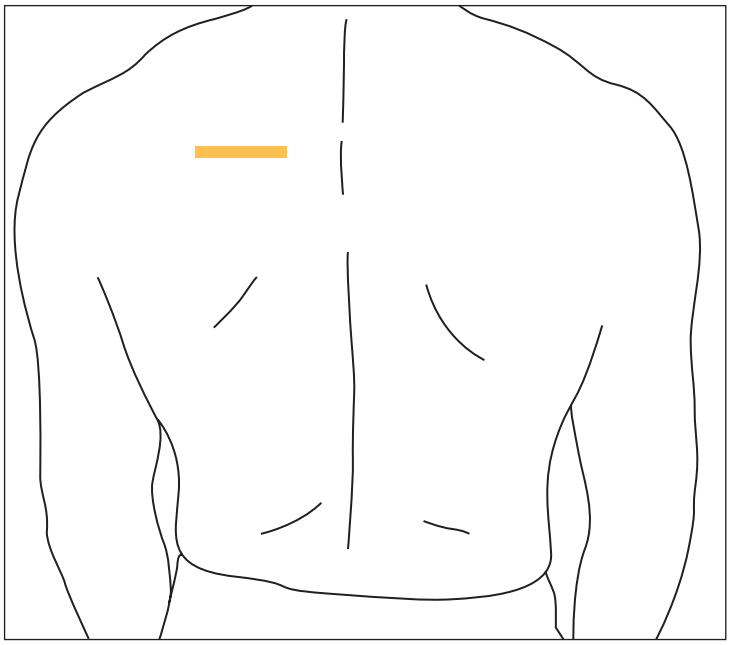

FIG. 20 TS of posterior chest wall, probe at medial border of scapula

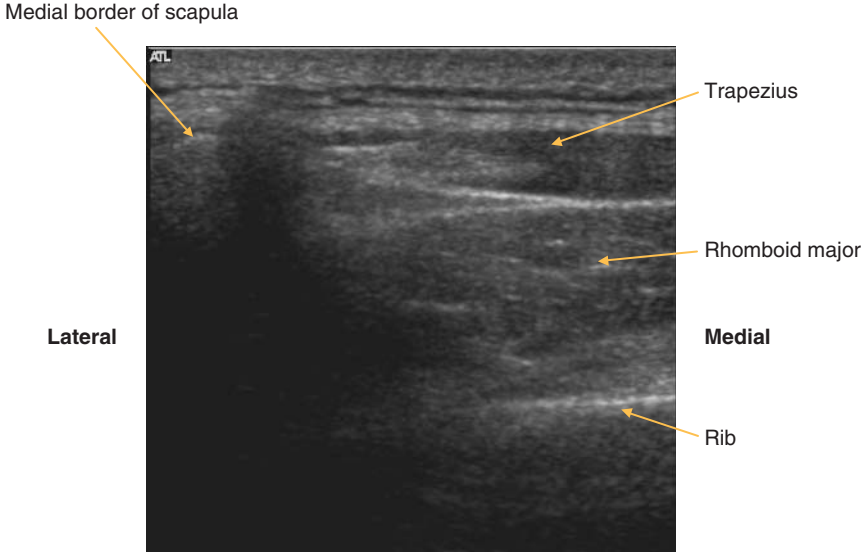

FIG. 21 TS, posterior chest wall

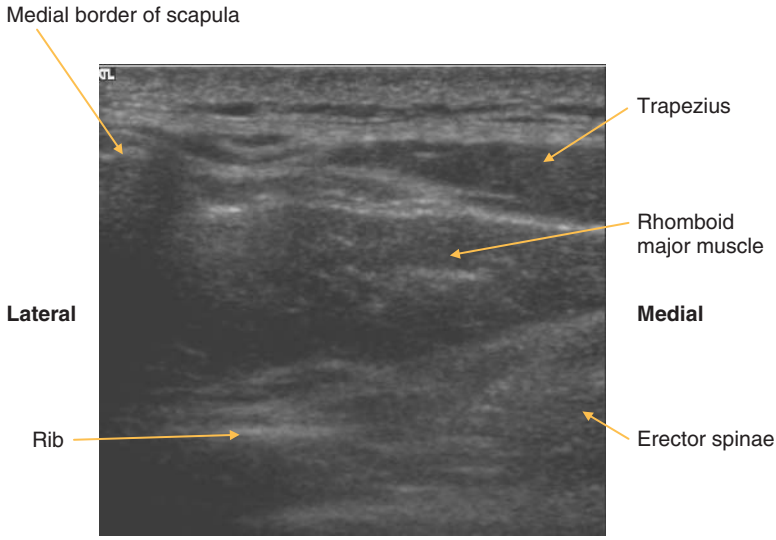

FIG. 22 TS, inferoposterior chest wall

Axilla

(Figures 23–27)

This pyramidal space contains important neurovascular structures (axillary vessels and the cords of the brachial plexus), and lymph nodes. It communicates at its apex with the posterior triangle of the neck.

- *Anterior wall*: anterior axillary fold containing pectoralis major, pectoralis minor, subclavius.
- *Posterior wall*: subscapularis, latissimus dorsi and teres major from above downwards.
- *Medial wall*: serratus anterior and underlying chest wall.
- *Lateral wall*: bicipital groove of humerus.

The clavicle, scapula and the outer aspect of the first rib form the apex.

Subscapularis

- Origin: medial two-thirds of the costal surface of the scapula.
- Insertion: lesser tuberosity of the humerus.

Notes

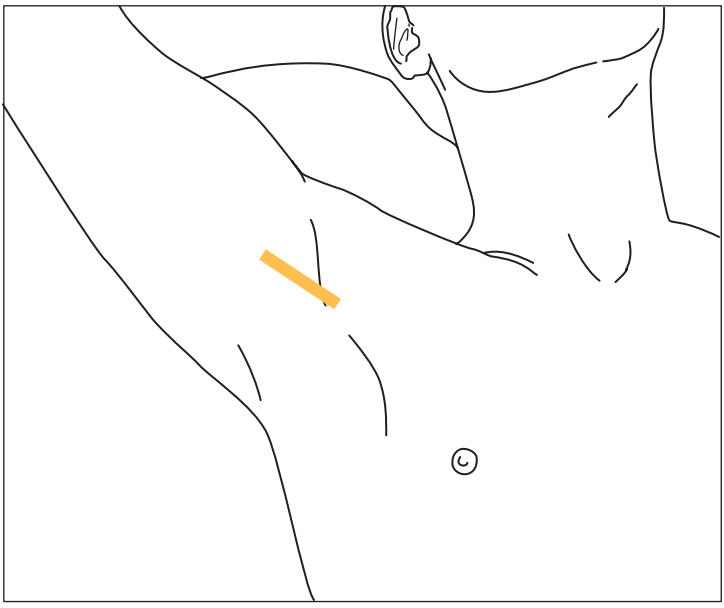

FIG. 23 LS of axilla, arm externally rotated and abducted

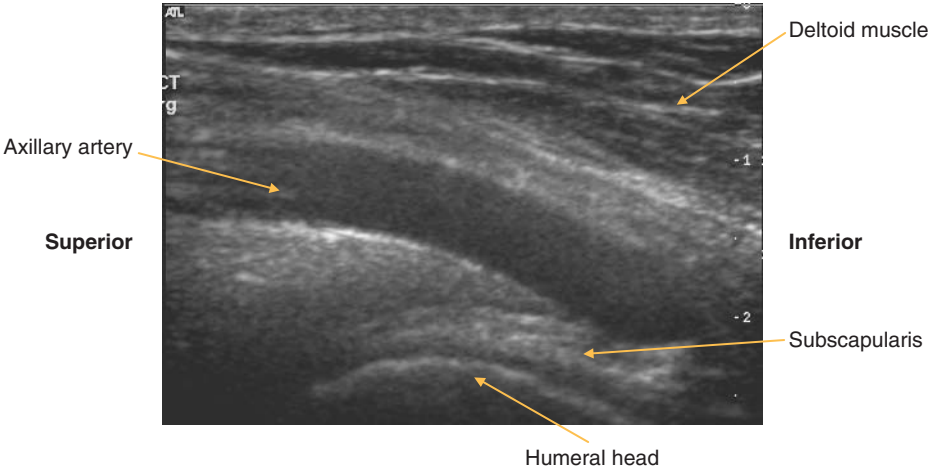

FIG. 24 LS of axilla

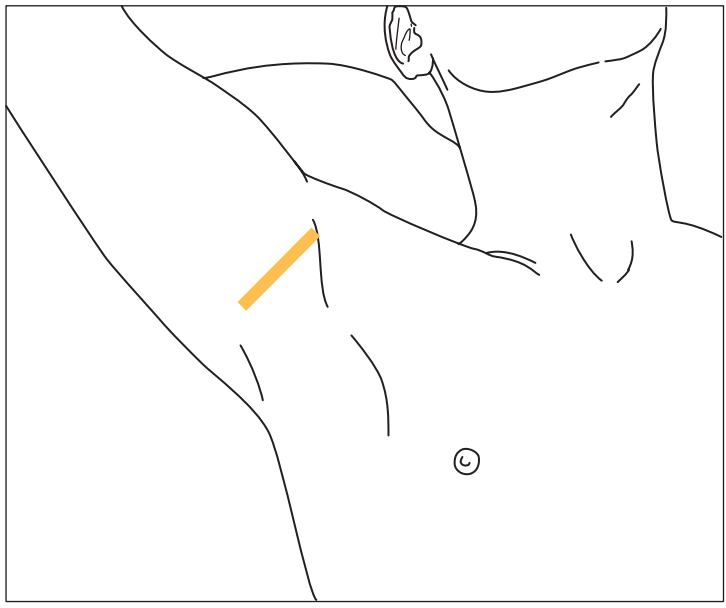

FIG. 25 TS of axilla, arm externally rotated and abducted

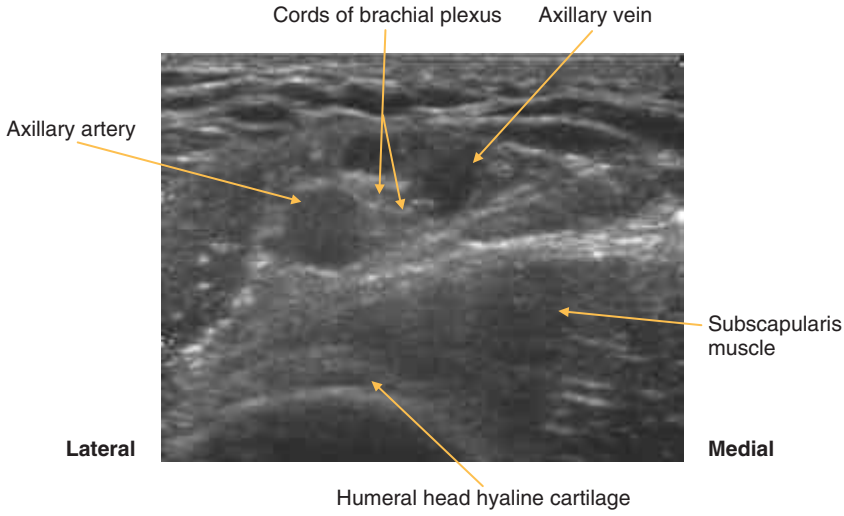

FIG. 26 TS of axilla

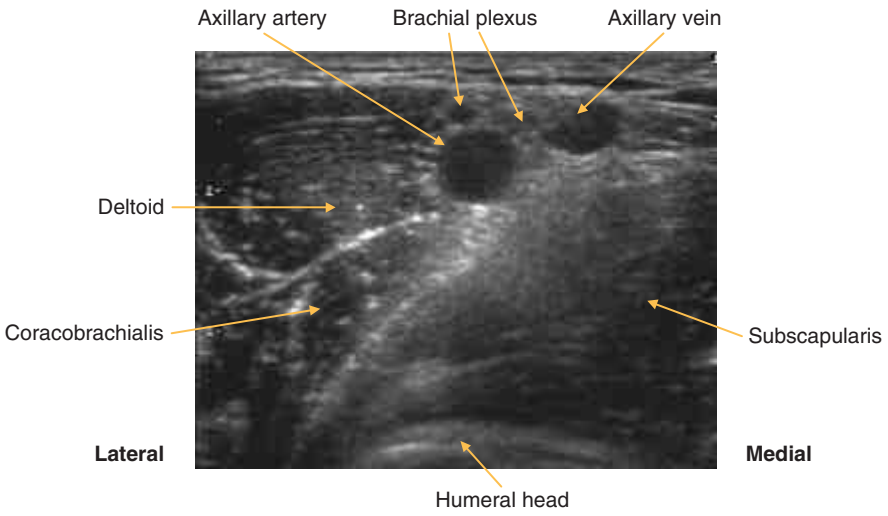

FIG. 27 TS of axilla

Upper limb

Shoulder 28
Upper arm 46
Elbow 50
Forearm 72
Wrist 82
Hand 96

Shoulder

Acromioclavicular joint

(Figures 28–30)

Atypical synovial joint (articular surfaces lined with fibrocartilage), containing an incomplete articular disc. Surrounding capsule thickened superiorly to form acromioclavicular ligament.

Notes

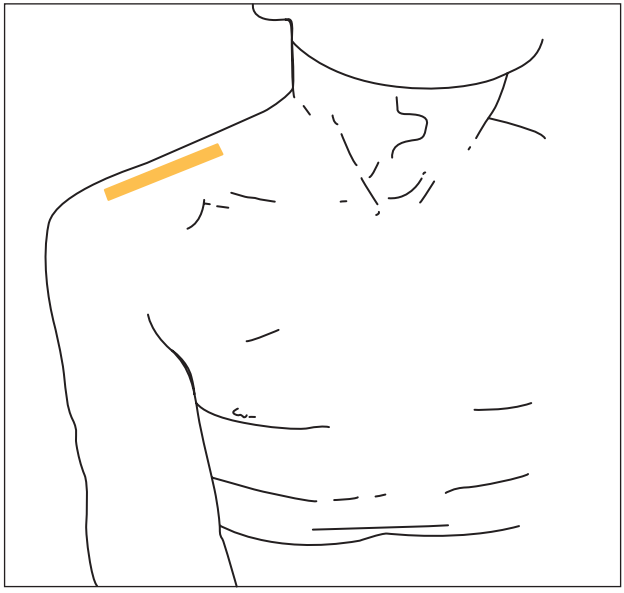

FIG. 28 Probe coronal adjacent to superior aspect of joint. Arm adducted

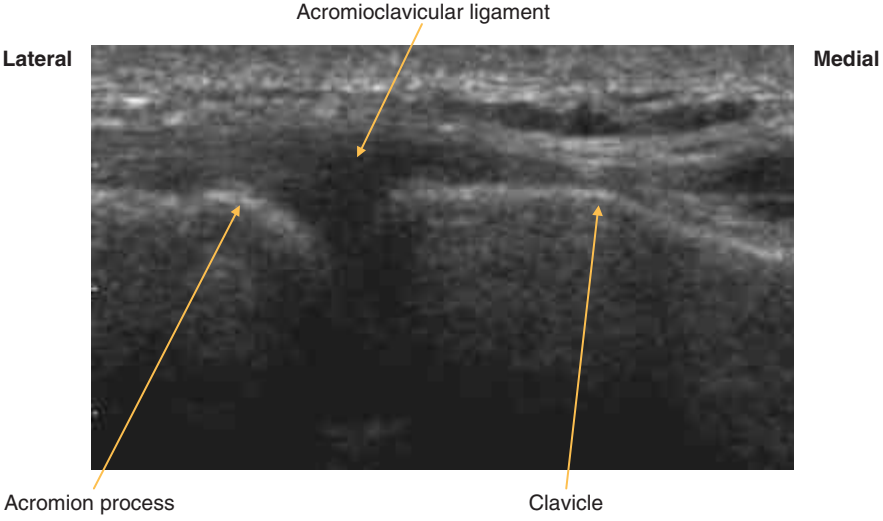

FIG. 29 LS, acromioclavicular joint

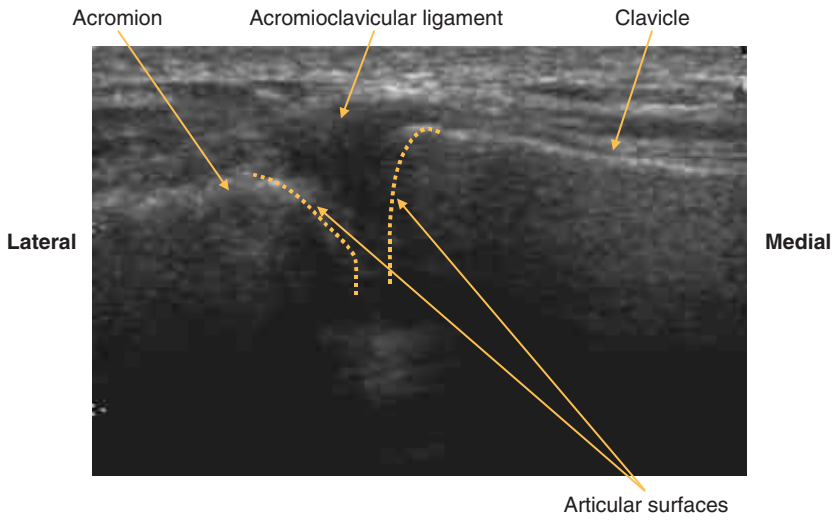

FIG. 30 LS, acromioclavicular joint

Long head of biceps

(Figures 31–35)

It arises from the supraglenoid tubercle and adjacent glenoid labrum (biceps–labral complex) and traverses the glenohumeral joint surrounded by synovium to enter the bicipital groove. It is rarely visible within the joint, but is reliably seen adjacent to the proximal humerus where it is contained within its groove by the transverse ligament.

Notes

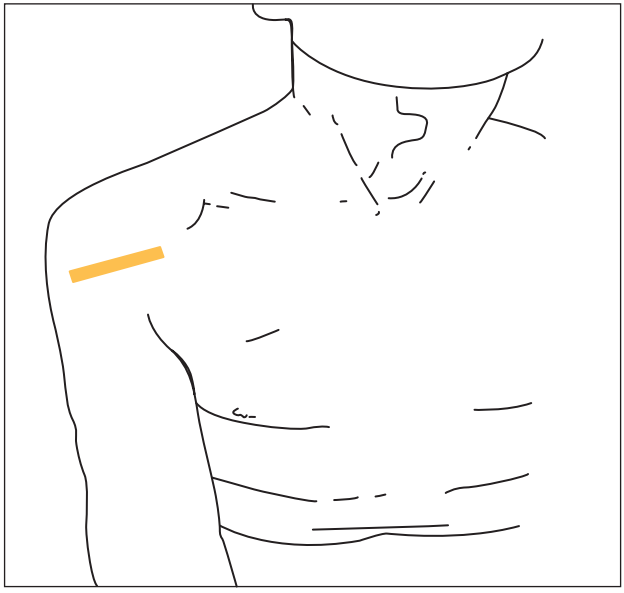

FIG. 31 TS, probe transverse across superior aspect of bicipital groove. Arm adducted, hand supinated. Examination of the rotator cuff is typically conducted from behind the patient

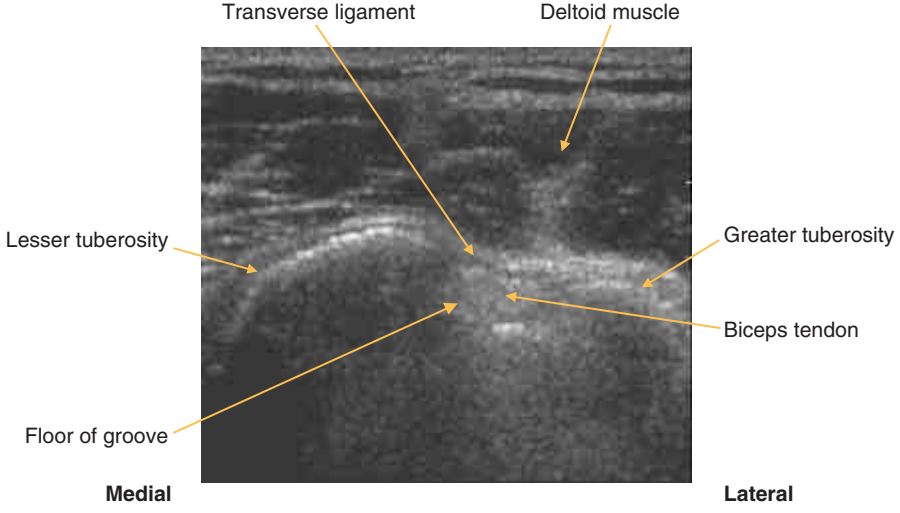

FIG. 32 TS, long head of biceps tendon

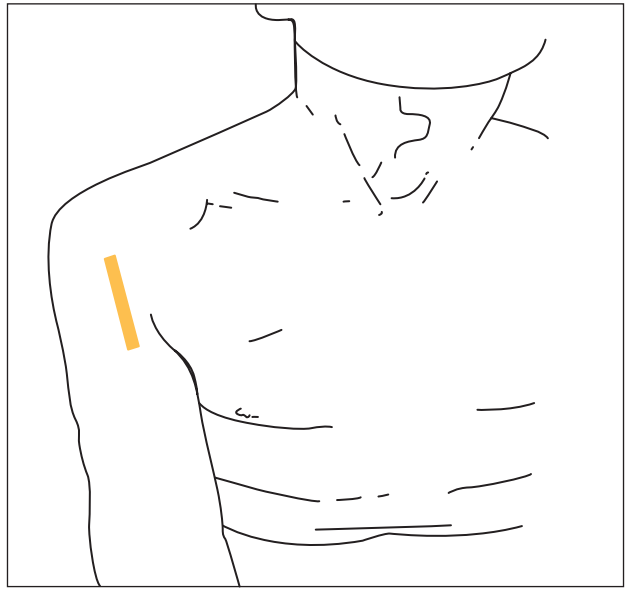

FIG. 33 LS, probe longitudinal to long head of biceps tendon. Arm adducted, hand supinated. Dynamic examination for subluxation of the tendon using internal and external rotation of the glenohumeral joint

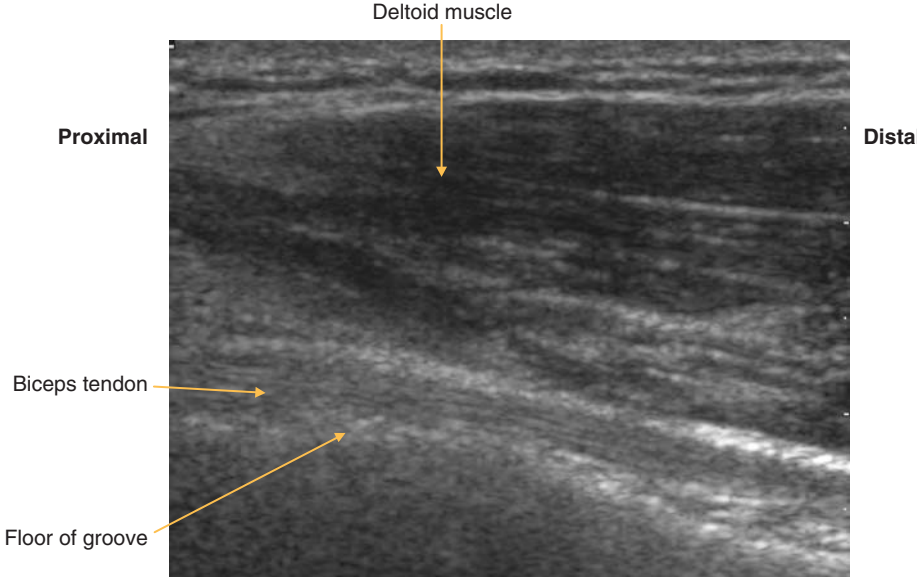

FIG. 34 LS, long head of biceps tendon

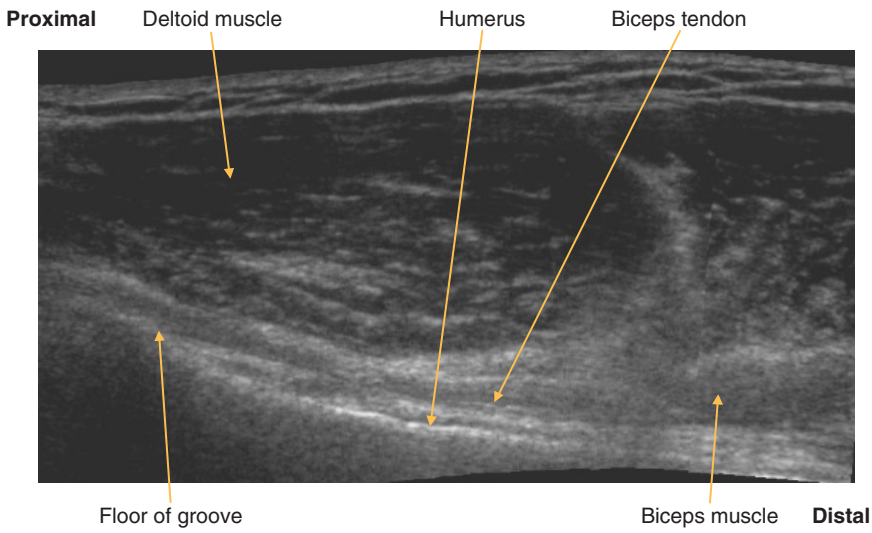

FIG. 35 LS panorama, long head of biceps

Subscapularis

(Figures 36–38)

It is a multipennate muscle, originating from the costal surface of the scapula, whose tendon inserts into the lesser tuberosity of the humerus. It is separated from the shoulder joint by its bursa, which generally communicates with the joint cavity. Forms part of posterior wall of axilla.

Notes

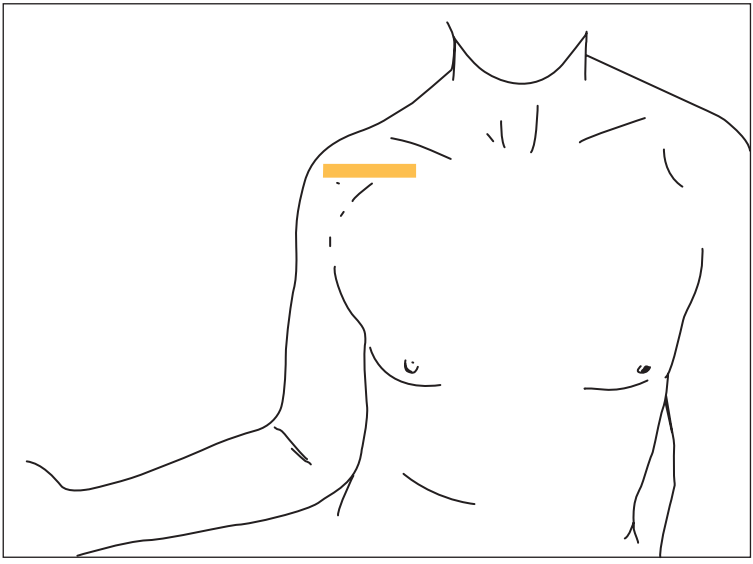

FIG. 36 LS, probe longitudinal to the subscapularis muscle (transverse to anterior shoulder). Arm externally rotated with elbow kept against chest wall. Dynamic examination using internal and external rotation of the glenohumeral joint

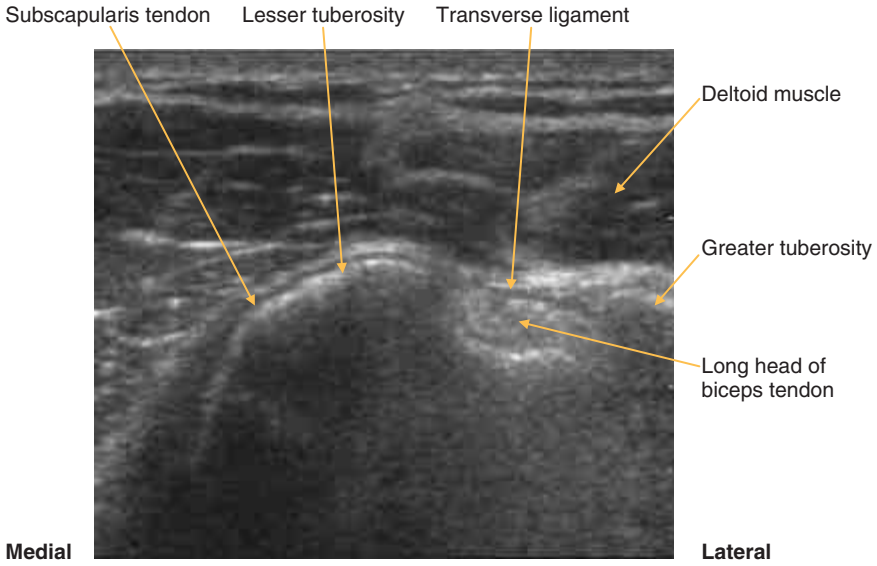

FIG. 37 TS, subscapularis tendon

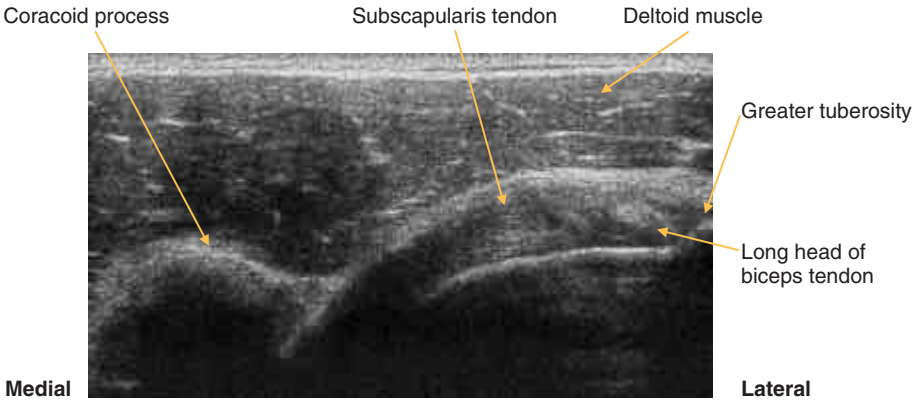

FIG. 38 TS, subscapularis tendon

Supraspinatus

(Figures 39–45)

Arises from the supraspinous fossa of the scapula and scapular spine. The tendon passes over the superior aspect of the shoulder joint to insert into the uppermost facet of the greater tuberosity of the humerus. The normal tendon shows a smooth, convex superior surface.

Notes

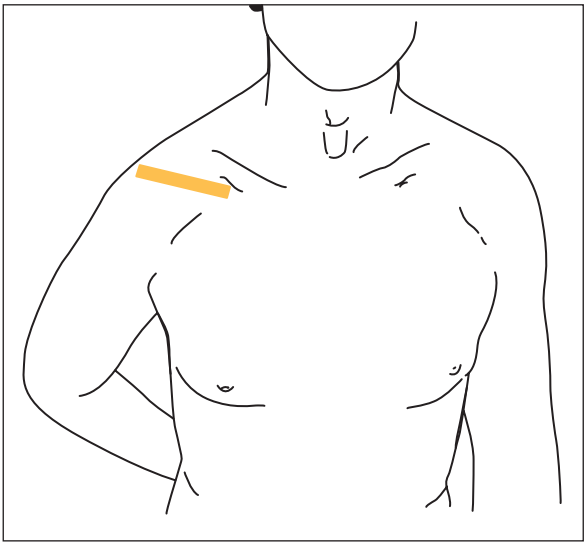

FIG. 39 TS, probe transverse to supraspinatus tendon, with shoulder extended and internally rotated. Shoulder extension with internal rotation is required for clear visualization (back of hand in small of back, or "hand-in wallet" position, elbow pointing posteriorly)

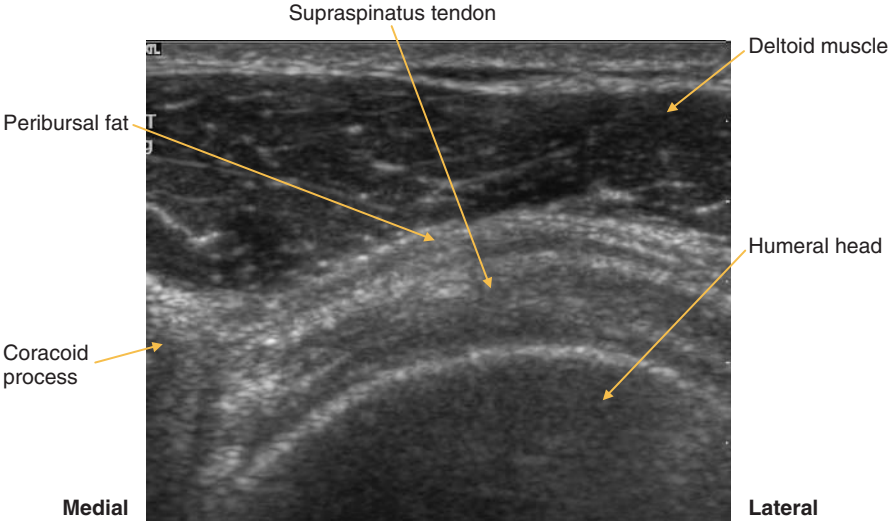

FIG. 40 TS, supraspinatus

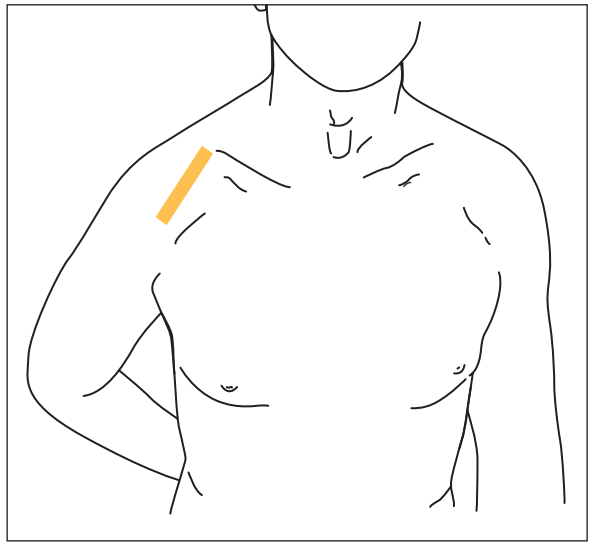

FIG. 41 LS, probe longitudinal to supraspinatus tendon, with shoulder extended and internally rotated

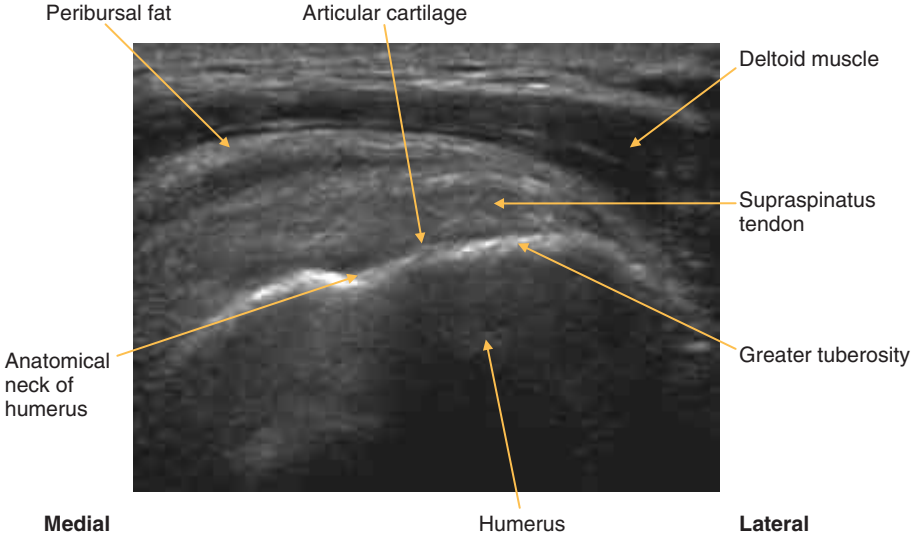

FIG. 42 LS, supraspinatus

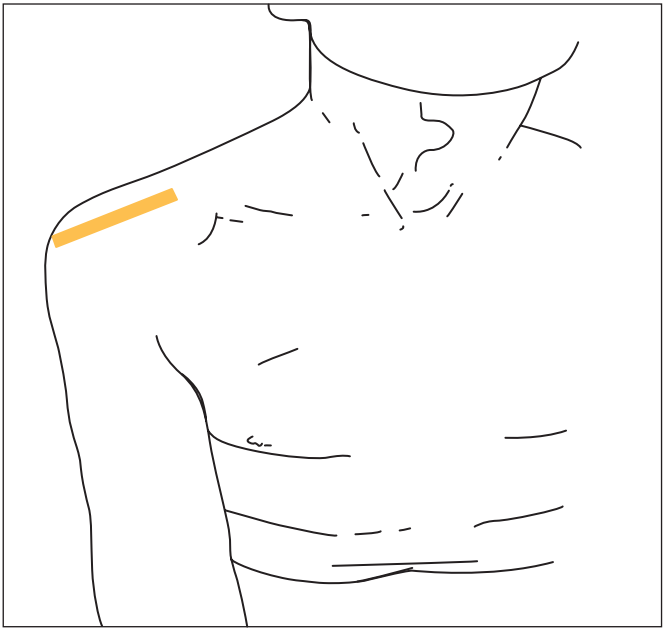

FIG. 43 Dynamic assessment of supraspinatus can be useful in the further evaluation of impingement and cuff tears. LS, probe over supraspinatus whilst abducting and adducting arm. This can be performed either from the front or back

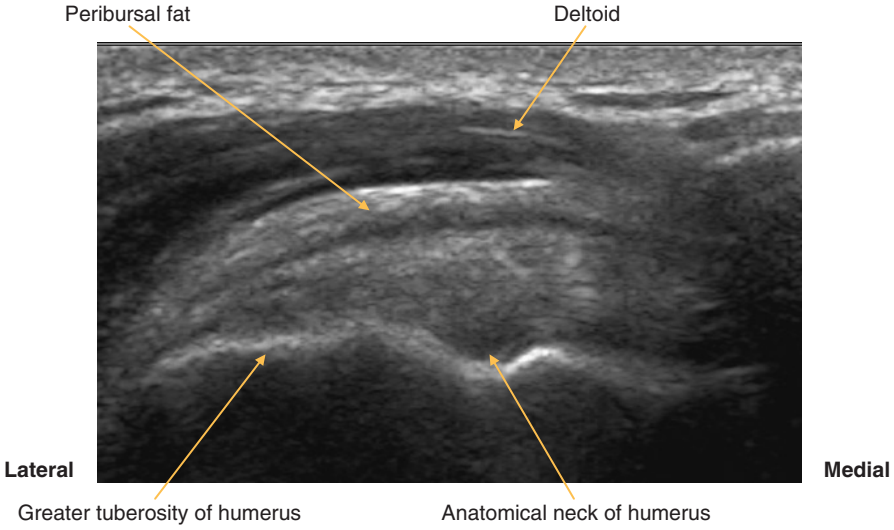

FIG. 44 LS, supraspinatus tendon in adduction

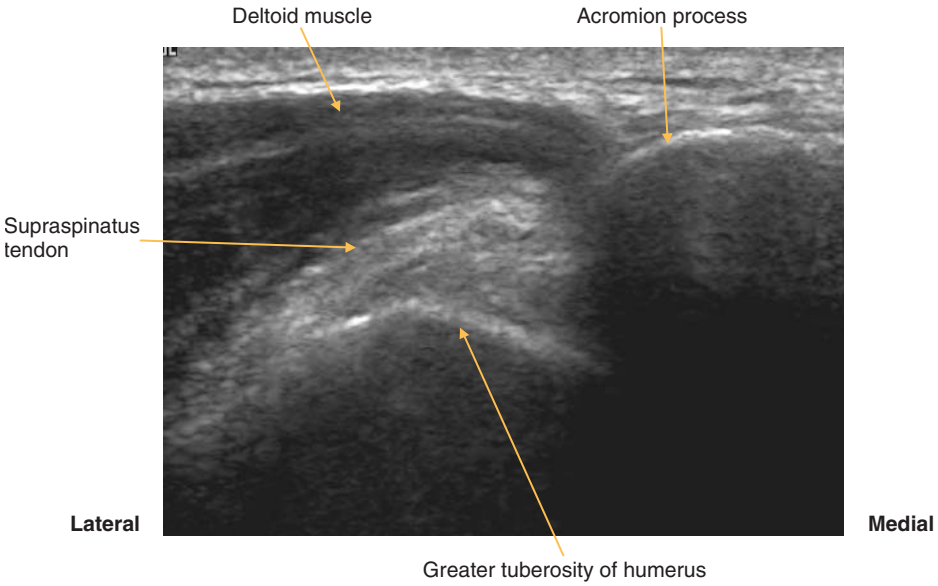

FIG. 45 LS, supraspinatus tendon in abduction

Infraspinatus

(Figures 46 and 47)

Arises from the infraspinous fossa on the posterior aspect of the scapula, inserting onto the middle facet of the greater tuberosity of the humerus. The muscular fibres extend laterally for a greater distance, which occasionally allows distinction of this tendon from the adjacent supraspinatus and teres minor, which form a continuous cuff tendon.

Notes

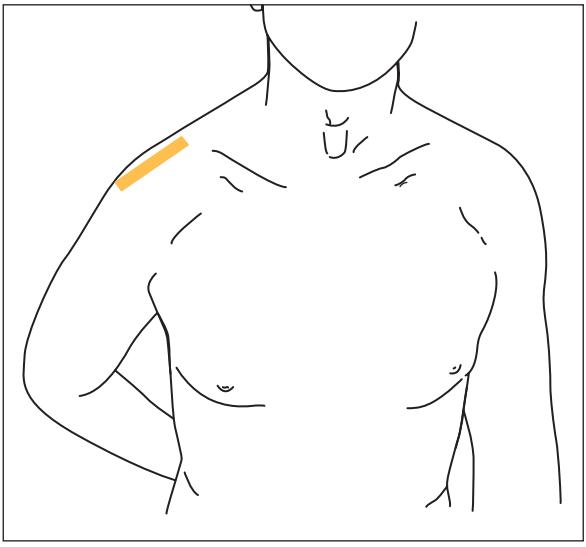

FIG. 46 LS, probe longitudinal to infraspinatus tendon with shoulder extended and internally rotated

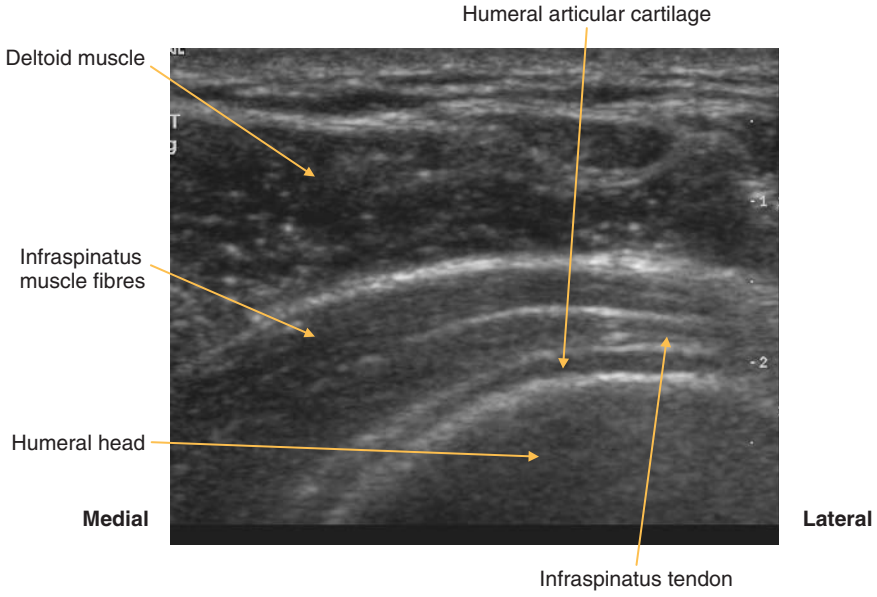

FIG. 47 LS, infraspinatus

Posterior joint

(Figures 48–51)

Visualizes infraspinatus and teres minor.

Teres minor

- Origin: upper two-thirds lateral border of scapula.
- Insertion, lower facet of greater tuberosity of humerus.

Notes

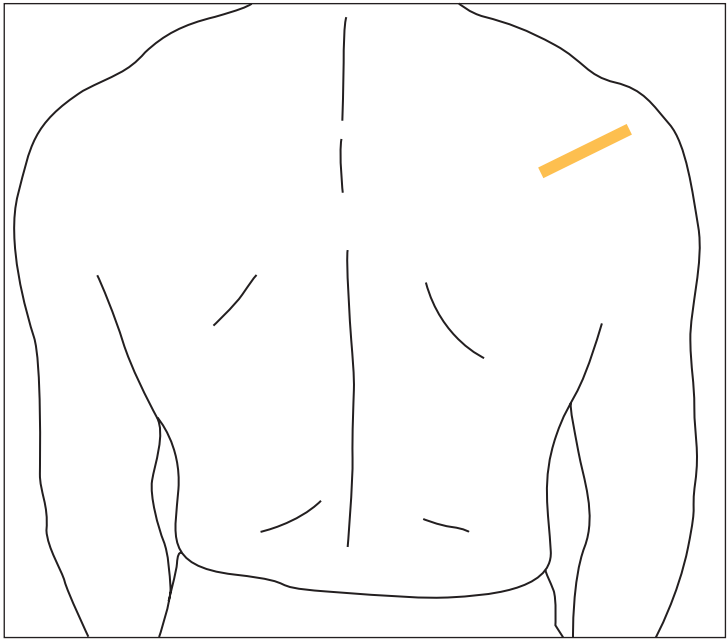

FIG. 48 LS, oblique probe longitudinal to infraspinatus. Arm adducted

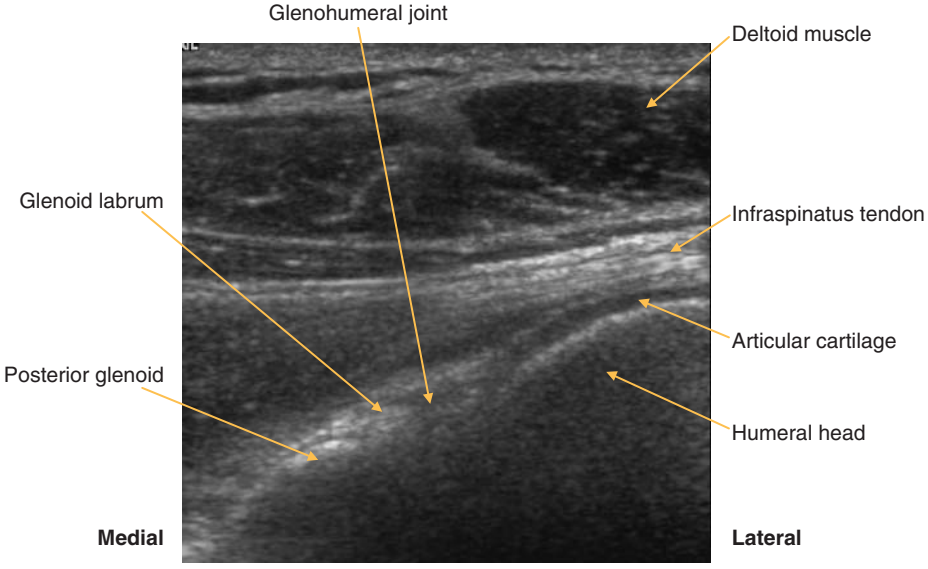

FIG. 49 Posterior shoulder

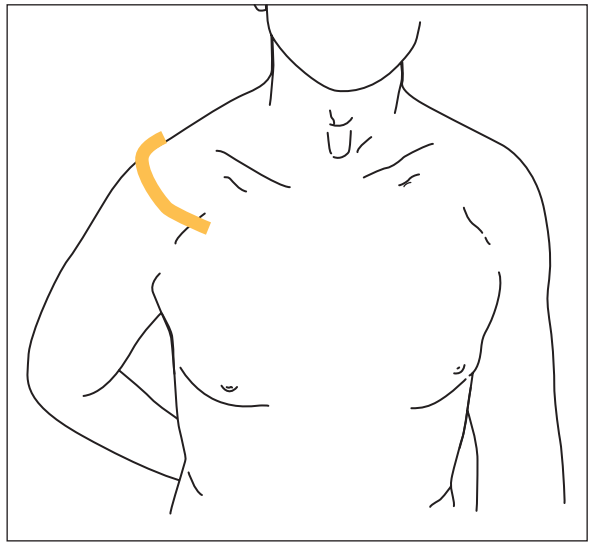

FIG. 50 TS panorama of rotator cuff

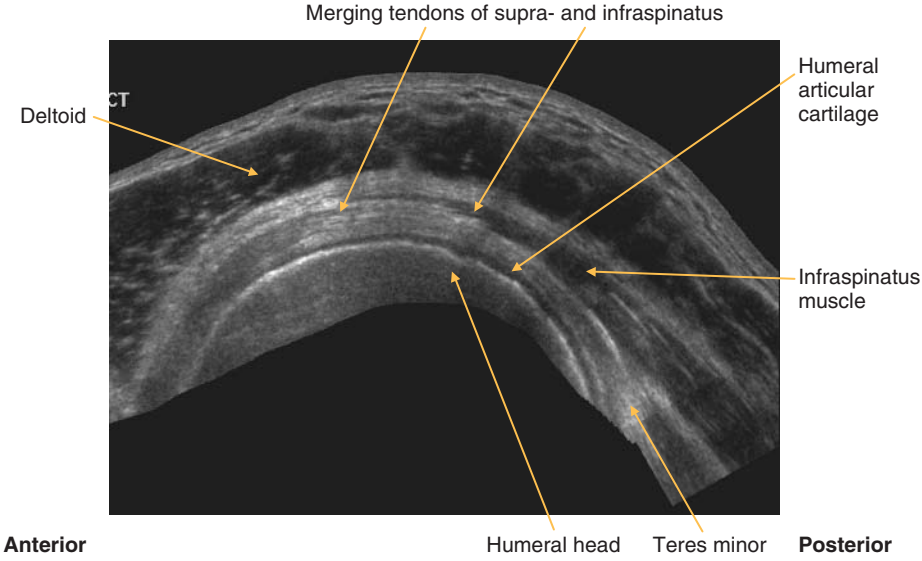

FIG. 51 TS panorama, rotator cuff

Upper arm

Anterior arm

(Figures 52–55)

At the midpoint of the upper arm, biceps is the most superficial muscle group, with brachialis separating it from humerus. The median nerve and brachial neurovascular bundle lie in a groove between biceps and triceps medially; the ulnar nerve/ulnar collateral artery lie adjacent to the median nerve posterior to the medial septum, and the radial neurovascular bundle, having passed posterior to the humerus in the spiral groove, pierces the lateral septum to enter the anterior compartment, eventually lying deep to brachioradialis.

- Brachialis
  - Origin: distal half of anterior humerus and medial intermuscular septum.
  - Insertion: anterior surface of coronoid process of ulna.
- Biceps
  - Origin: short head from tip of corcoid process, long head from supraglenoid tubercle.
  - Insertion: posterior part of radial tuberosity and the bicipital aponeurosis.
- Coracobrachialis
  - Origin: tip of coracoid process.
  - Insertion: mid-medial humerus.

Notes

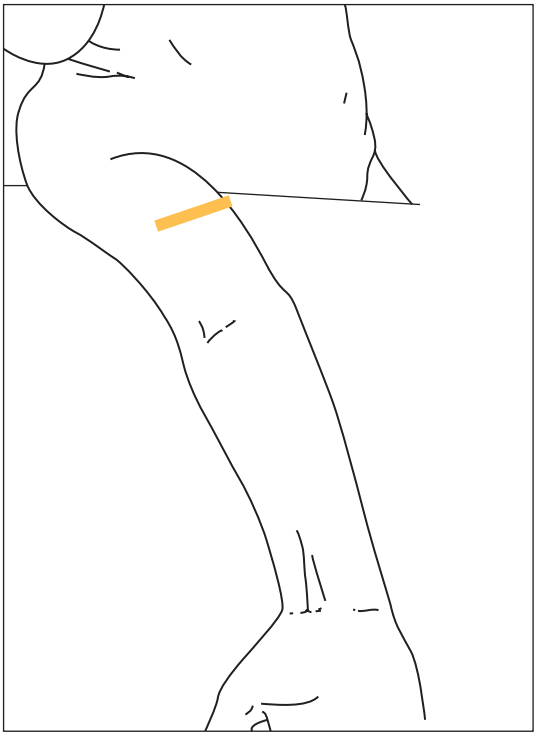

FIG. 52 TS, probe transverse to anterior aspect of arm

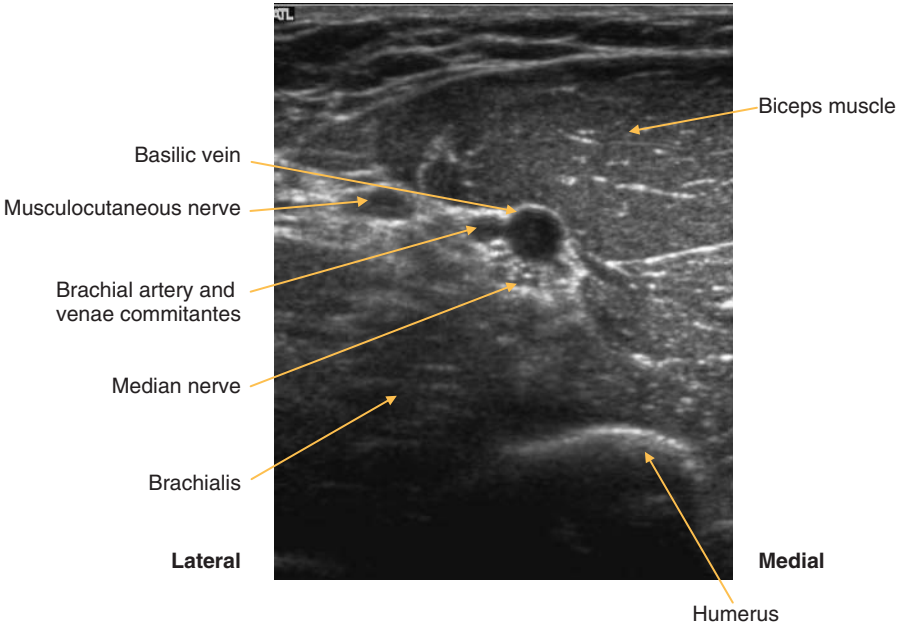

FIG. 53 TS, brachial neurovascular bundle

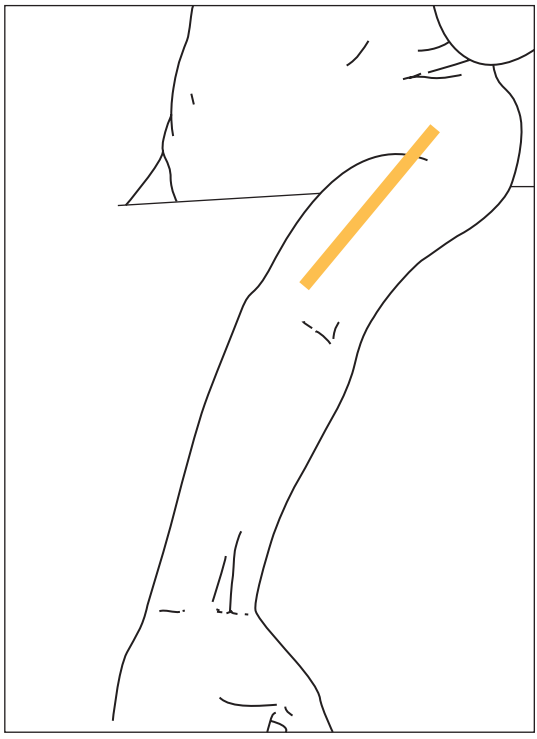

FIG. 54 LS panorama, probe longitudinal to anterior arm

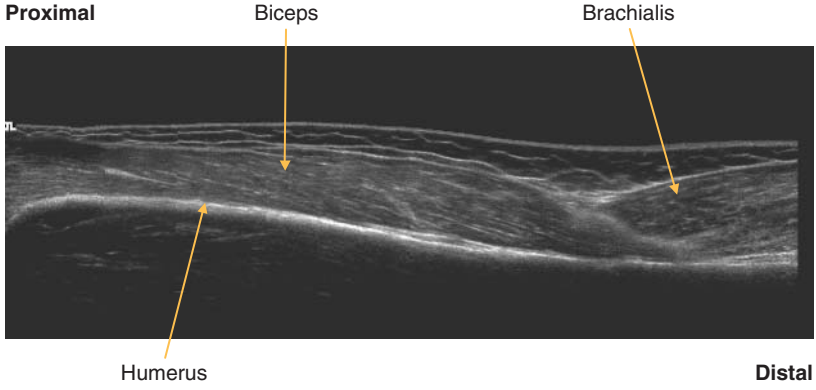

FIG. 55 LS panorama, biceps

Posterior arm

(Figures 56 and 57)

- Triceps
  - Origin: long head from the infraglenoid tubercle, lateral head from upper border of radial groove of humerus, medial head from posterior surface of humerus and intermuscular septum.
  - Insertion: olecranon process of ulna.

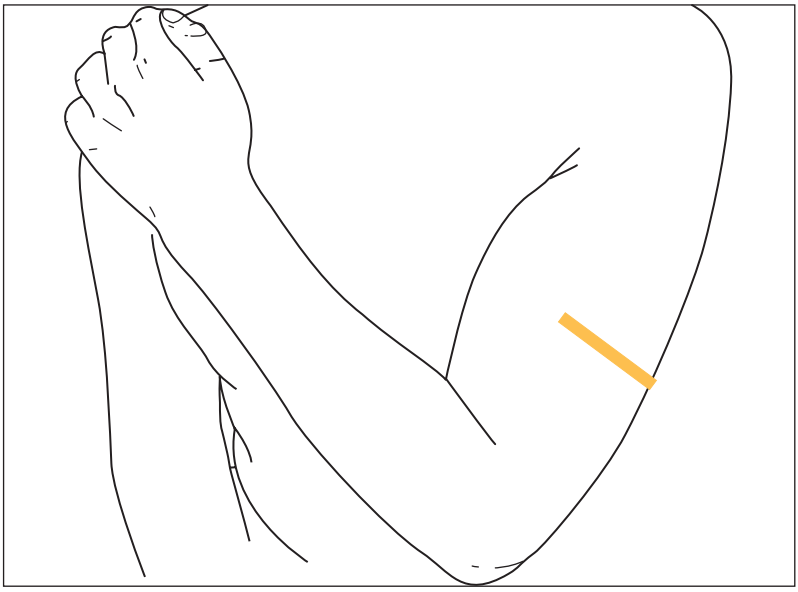

FIG. 56 TS, probe transverse to posterior aspect of arm, arm adducted and elbow flexed (holding opposite shoulder)

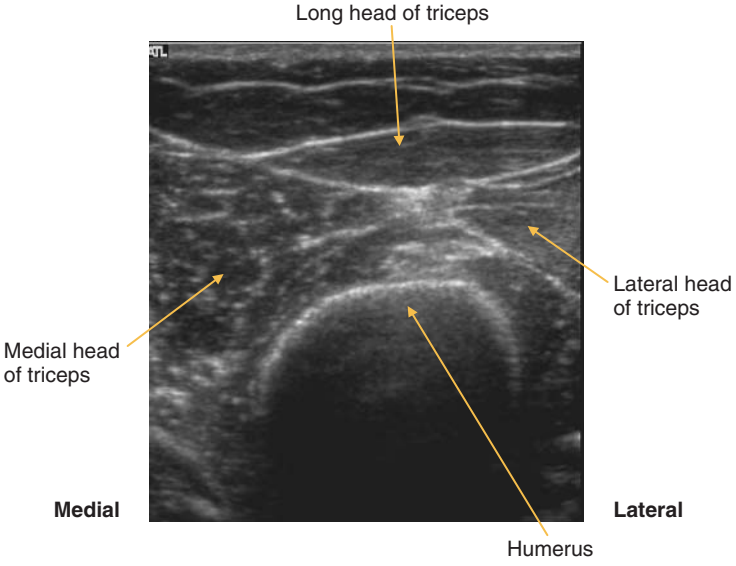

FIG. 57 TS, posterior aspect of arm

Elbow

Lateral elbow

(Figures 58 and 59)

Important anatomical structures in this region of the elbow include the common extensor origin (CEO). This comprises the fused tendons of extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi and extensor carpi ulnaris which attach anteriorly to the lateral epicondyle of the humerus.

The superficial group of posterior and lateral forearm muscles are brachioradialis and extensor carpi radialis longus. They originate proximal to the CEO, from the lateral supracondylar ridge of the humerus.

- Brachioradialis
  - Origin: lateral supracondylar ridge of humerus.
  - Insertion: lateral aspect distal radius.
- Extensor carpi radialis longus
  - Origin: lateral supracondylar ridge of humerus.
  - Insertion: dorsal surface base of index finger metacarpal.

Notes

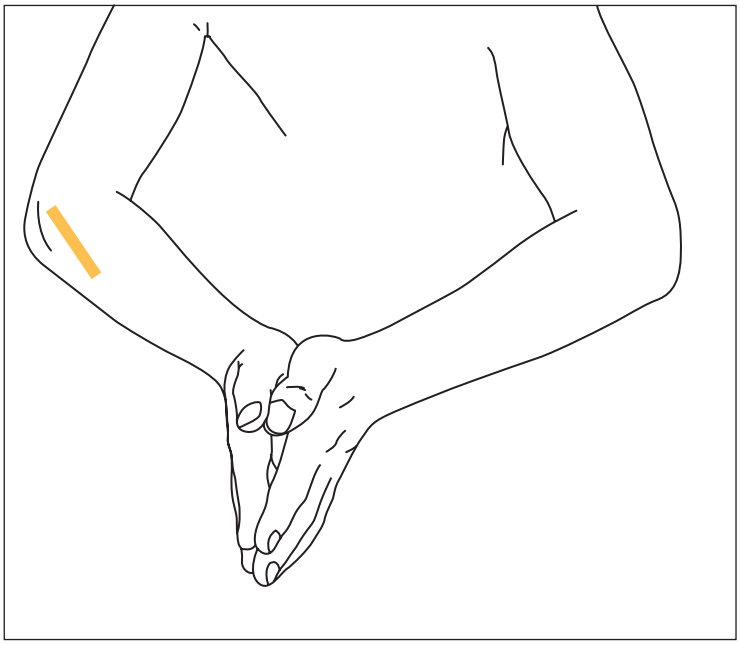

FIG. 58 LS, probe longitudinal to radial aspect of elbow, patient in "praying" position

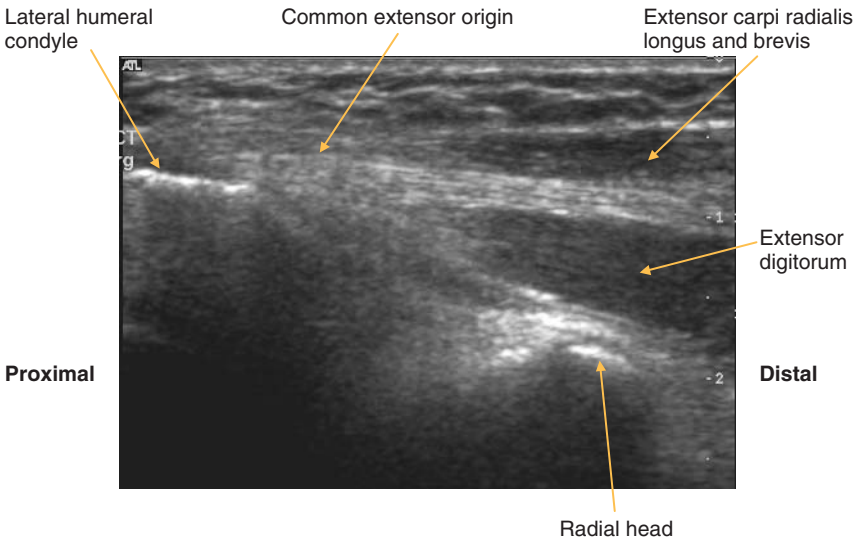

FIG. 59 LS, common extensor origin

The radiocapitellar joint and annular ligament

(Figures 60–63)

Annular ligament

Encircles head of radius, attached to the anterior and posterior borders of the radial notch of the ulna.

Notes

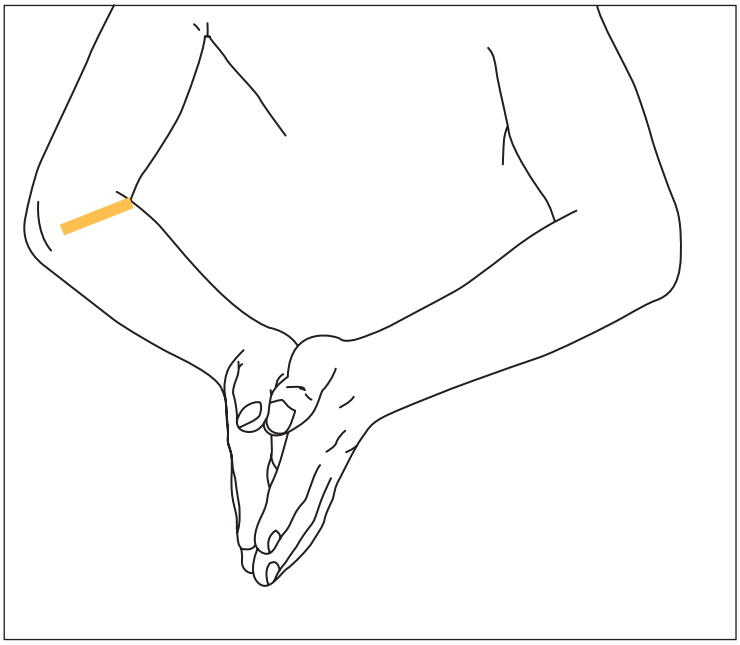

FIG. 60 TS, probe transverse to radiocapitellar joint, patient in "praying" position

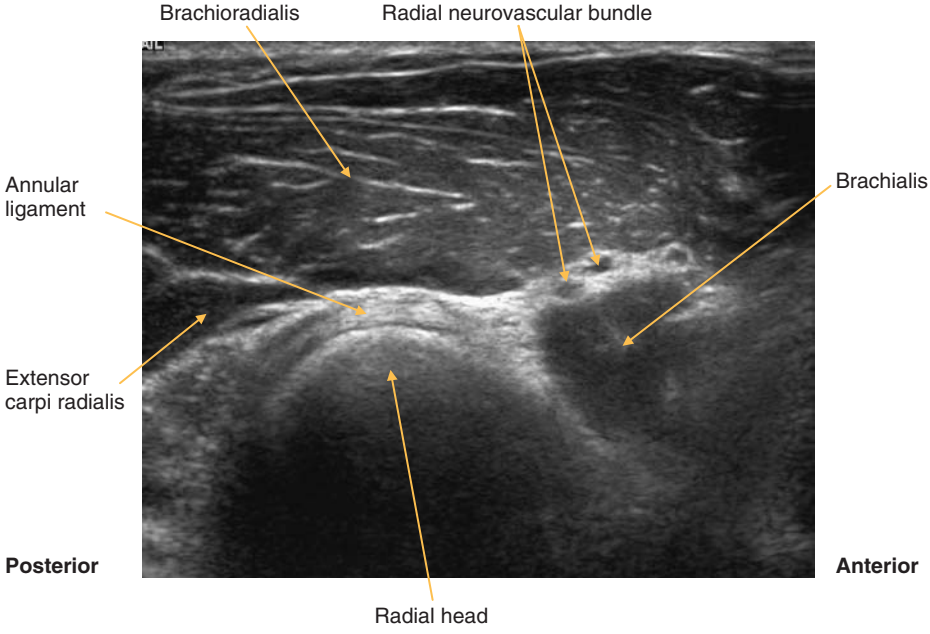

FIG. 61 TS, elbow lateral

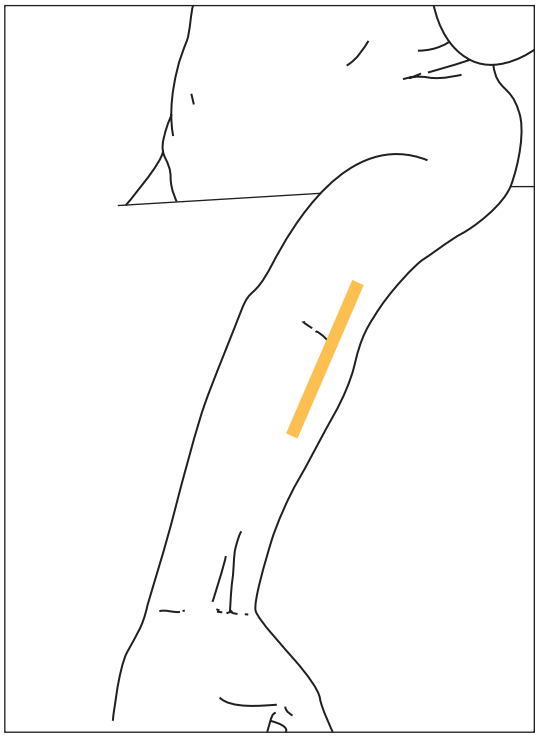

FIG. 62 LS panorma, probe longitudinal to antero-lateral elbow

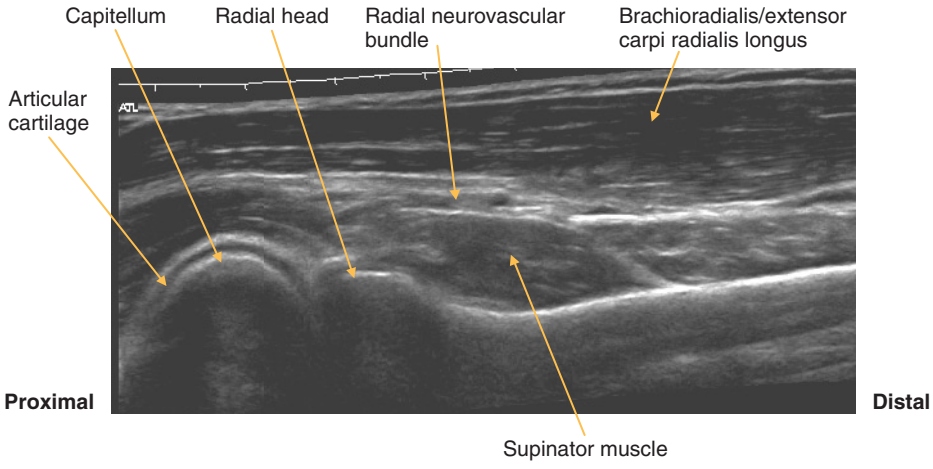

FIG. 63 LS panorama, anterolateral elbow

Anterior elbow

(Figures 64 and 65)

Visualizes the anterior aspect of the elbow joint, neurovascular structures and biceps tendon.

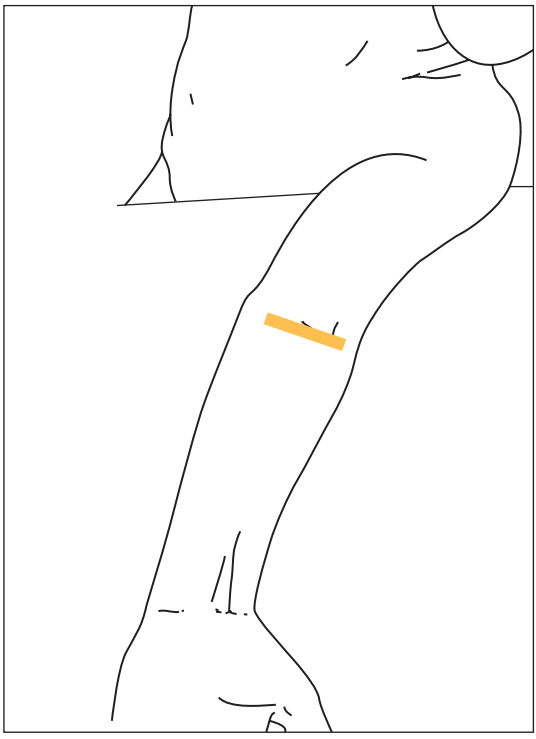

FIG. 64 TS, probe transverse to anterior elbow, arm extended

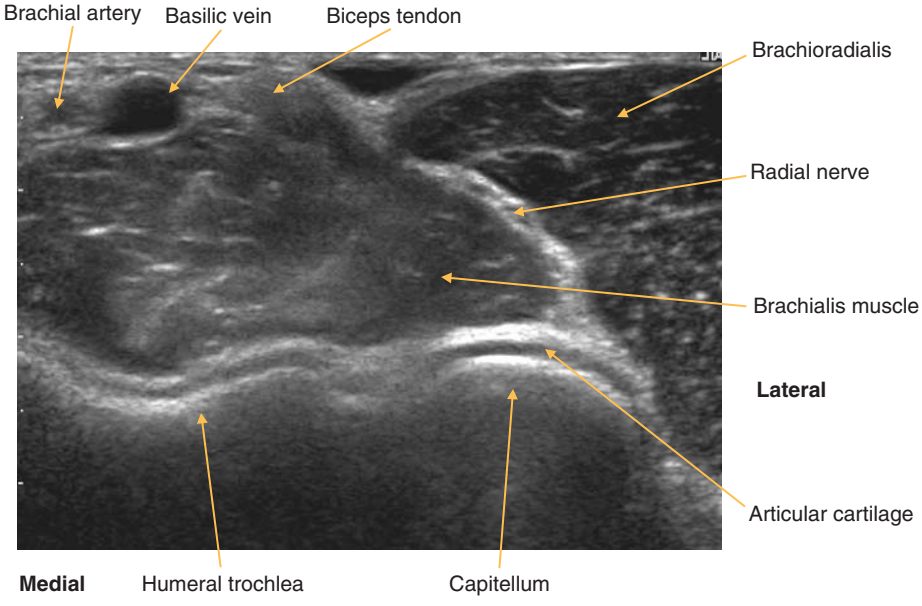

FIG. 65 TS, anterior elbow

Biceps tendon

(Figures 66–70)

It inserts onto the tuberosity of the radius, and a bursa separates bone and tendon just proximal to the insertion. Further insertions are via the bicipital aponeurosis into the deep fascia on the ulnar aspect of the forearm and posterior subcutaneous border of the ulna.

It can be difficult to demonstrate the tendon due to anisotropy as it travels deeper to its insertion.

Notes

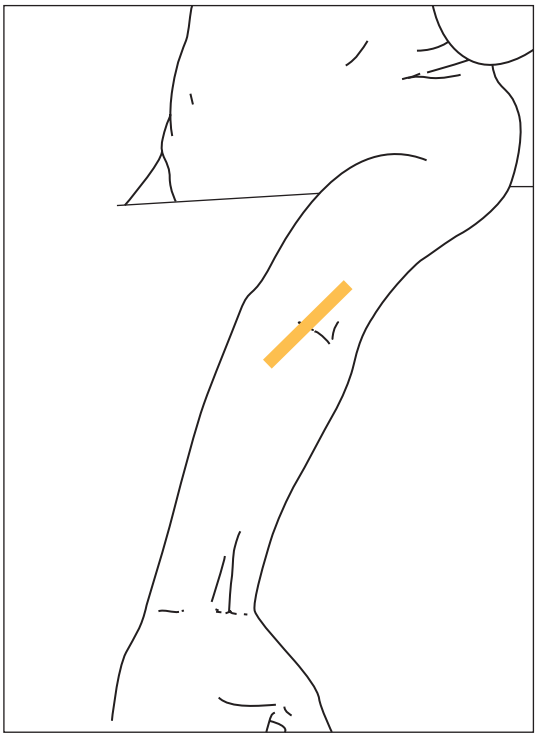

FIG. 66 LS, probe longitudinal to distal biceps tendon, slightly oblique to long axis of upper limb

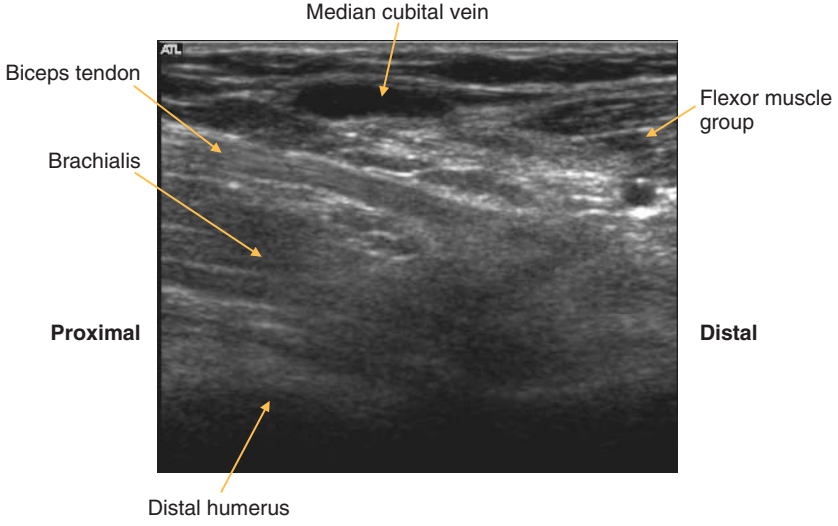

FIG. 67 LS, anterior elbow

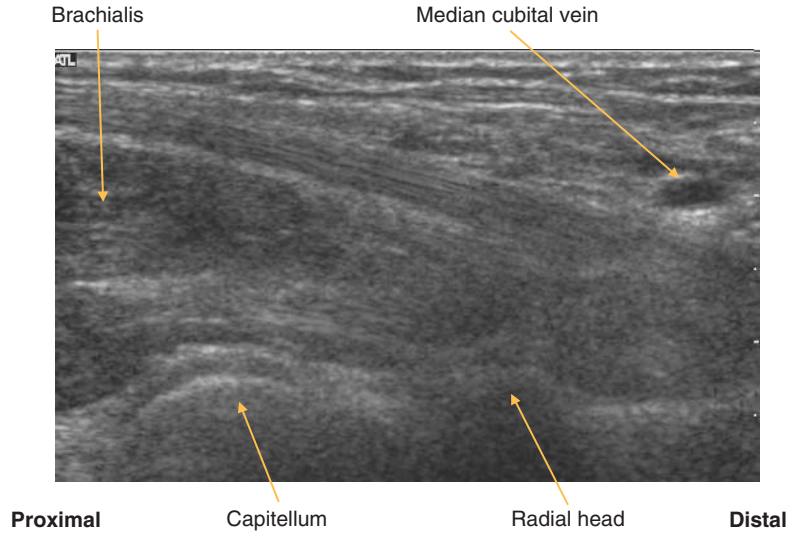

FIG. 68 LS, biceps tendon

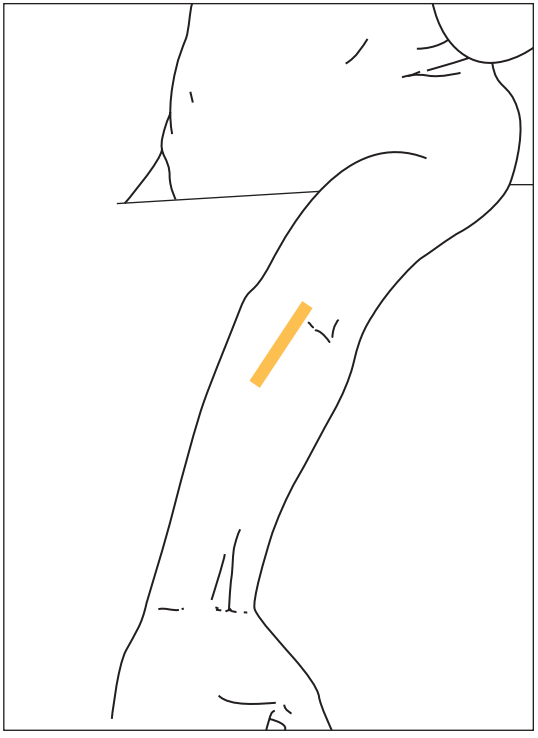

FIG. 69 LS, probe longitudinal to antero-medial aspect of elbow

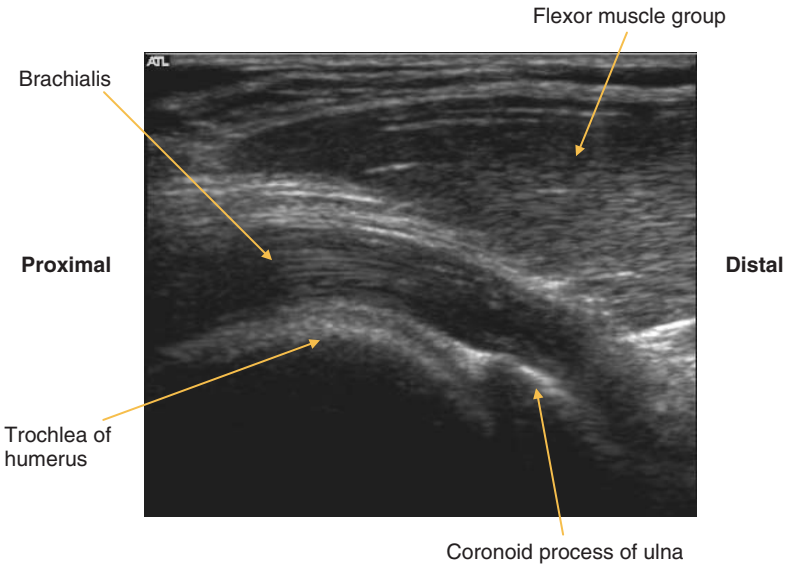

FIG. 70 LS, antero-medial elbow

Medial elbow

(Figures 71 and 72)

Pathologically and anatomically important structures here include the common flexor origin (CFO), ulnar collateral ligament and medial aspect of the elbow joint.

The CFO is situated anteriorly on the medial epicondyle of the humerus, and gives origin to the superficial muscle group of pronator teres, flexor carpi radialis, flexor digitorum superficialis, palmaris longus and flexor carpi ulnaris. These muscles form the medial border of the cubital fossa.

The deep forearm muscles include flexor pollicis longus, flexor digitorum profundus and pronator quadratus.

Notes

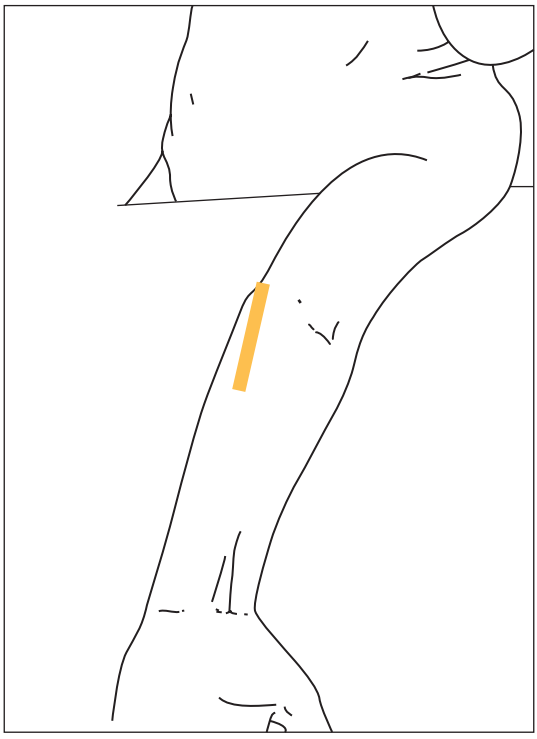

FIG. 71 LS, probe longitudinal to antero-medial elbow, access to which is improved if the patient leans to that side

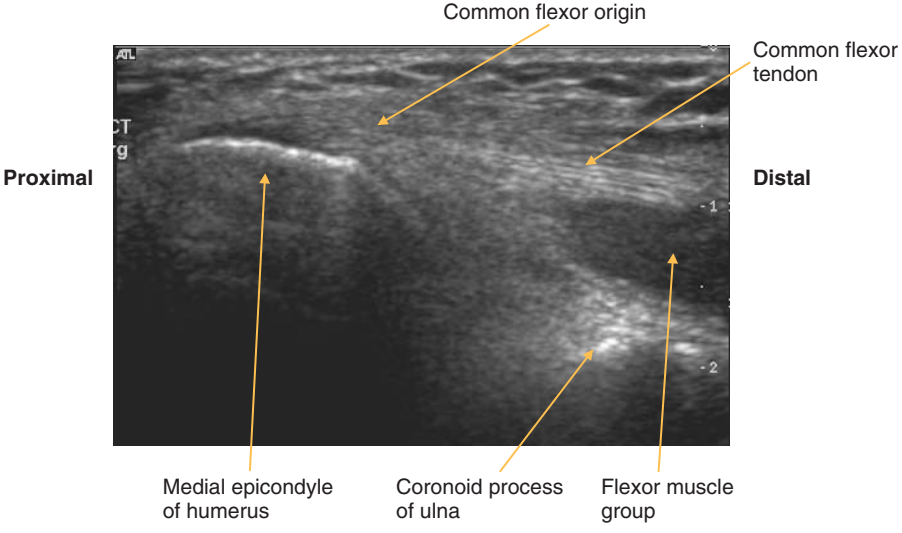

FIG. 72 LS, common flexor origin

Ulnar collateral ligament (UCL)

(Figures 73–76)

This triangular ligament has three parts:

- The strongest is the anterior band, which can be seen deep to the CFO, running from the medial epicondyle of the humerus to the coronoid process of the ulna (the "sublime" tubercle).
- The posterior band runs posteriorly from the sublime tubercle to the olecranon.
- The middle band spans anterior and posterior.

Notes

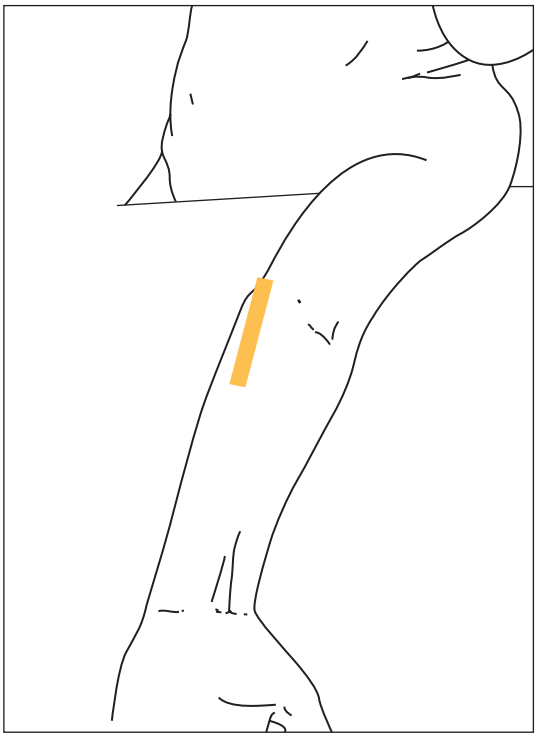

FIG. 73 LS, probe longitudinal to medial elbow (similar position to CFO)

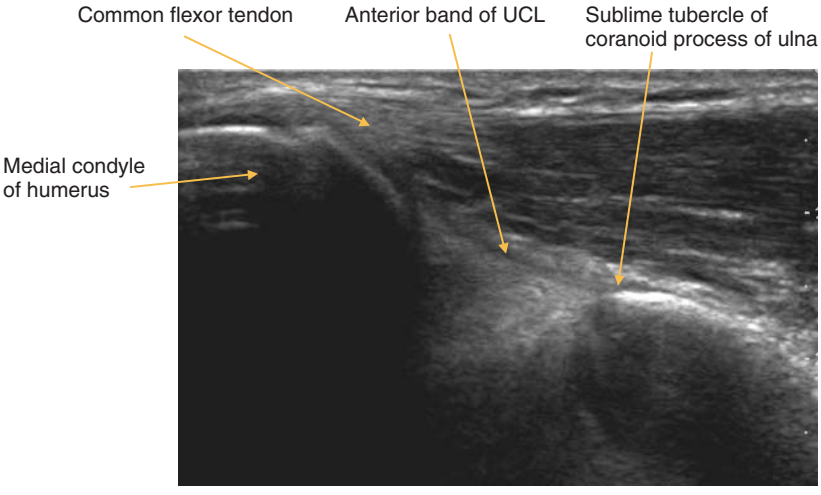

FIG. 74 LS, medial elbow showing UCL

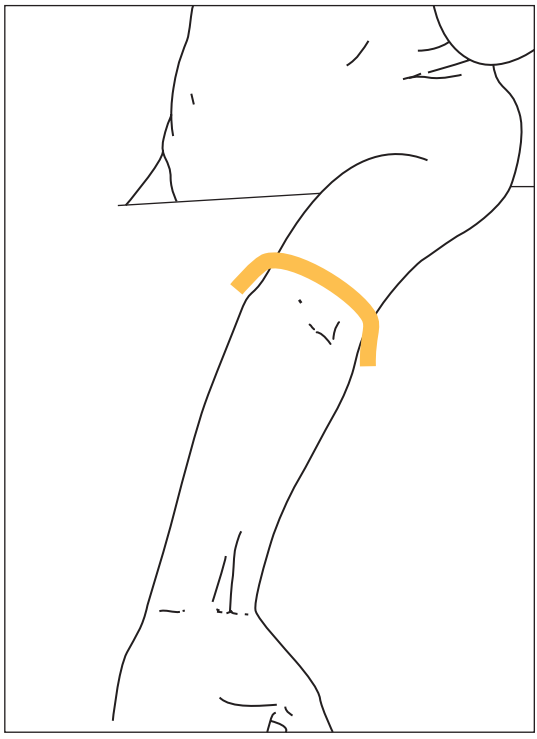

FIG. 75 TS panorama, anterior elbow

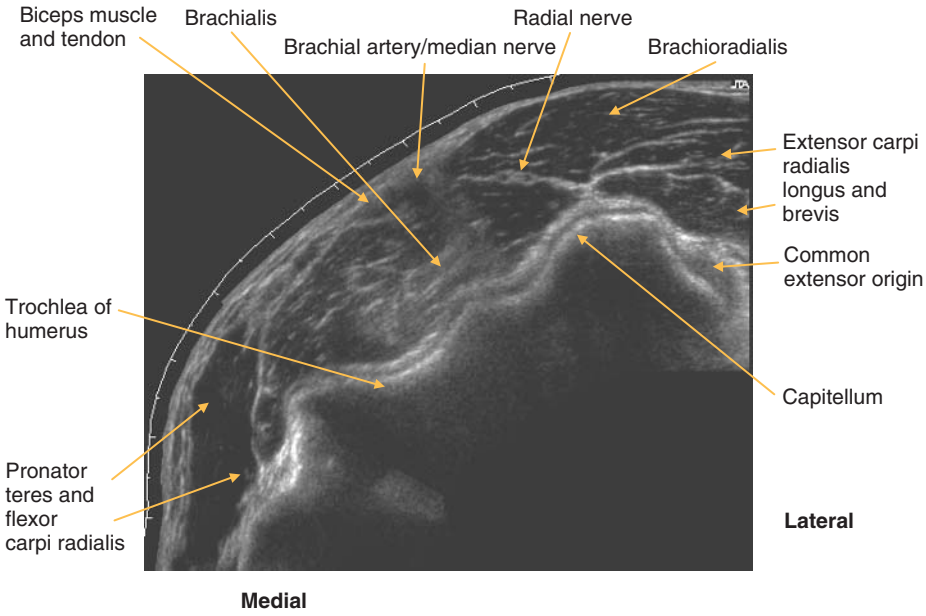

FIG. 76 TS panorama, anterior elbow

Posterior elbow

(Figures 77–81)

The triceps tendon attaches to the olecranon of the ulna.

The ulnar nerve can be seen in a groove posterior to medial humeral epicondyle.

Examination of the posterior elbow is facilitated by placing the joint in one of the two positions

- Patient in "crab" position.
- Patient holding contralateral shoulder.

Notes

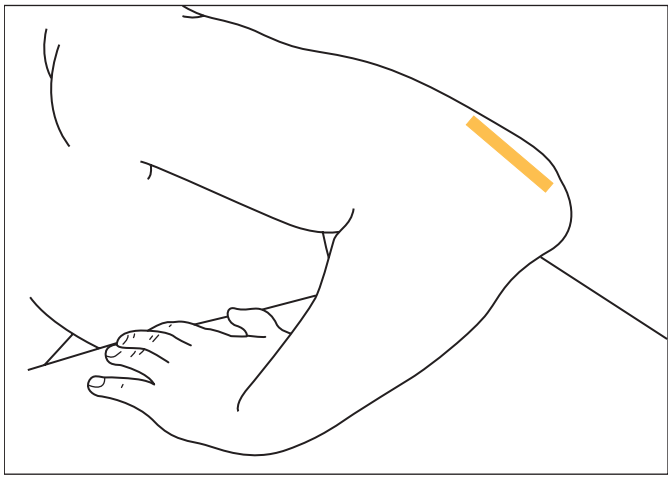

FIG. 77 LS, probe longitudinal to posterior elbow, patient in "crab" position

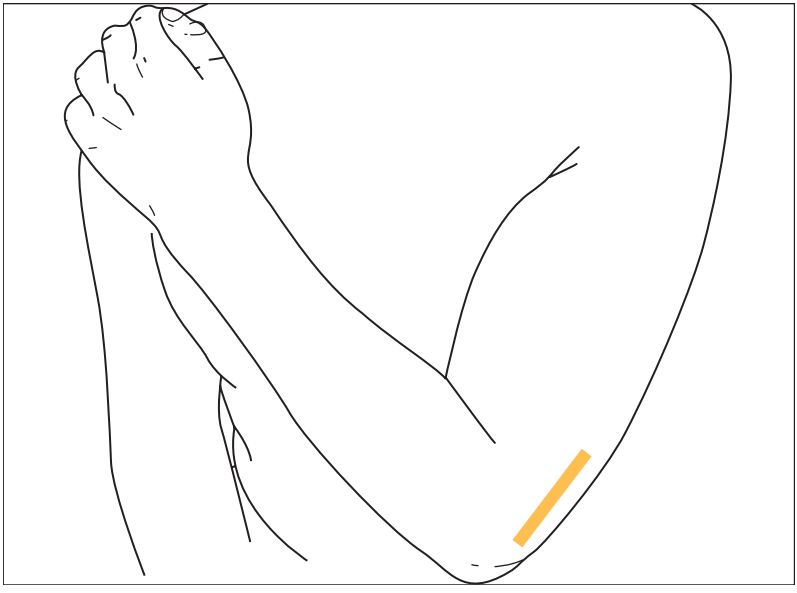

FIG. 78 LS, probe longitudinal to posterior elbow, patient holding contralateral shoulder

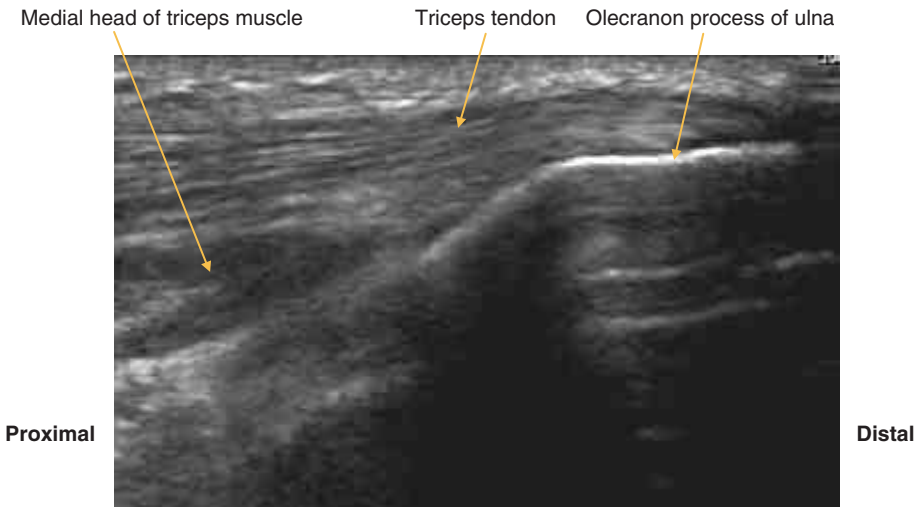

FIG. 79 LS, posterior elbow

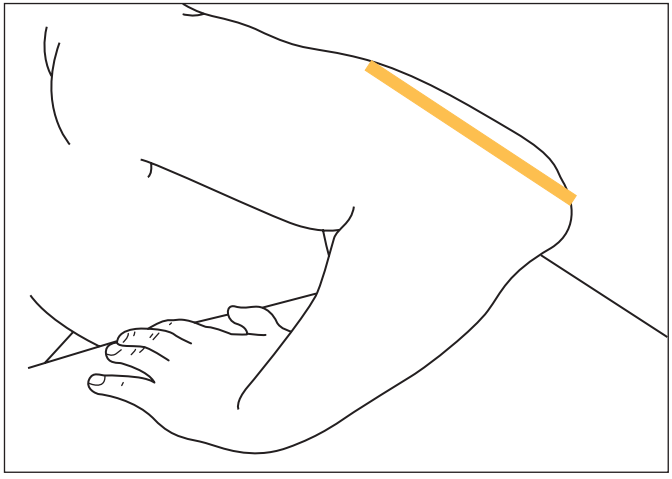

FIG. 80 LS panorama, posterior elbow

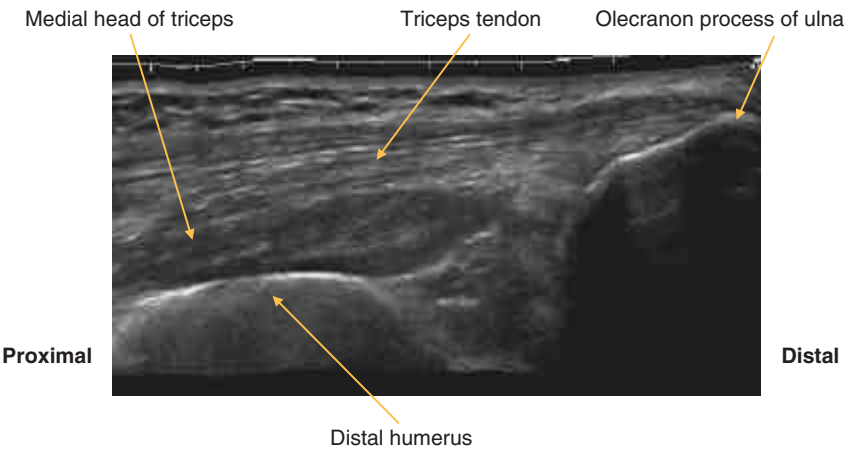

FIG. 81 LS panorama, triceps

Ulnar nerve

(Figures 82 and 83)

Notes

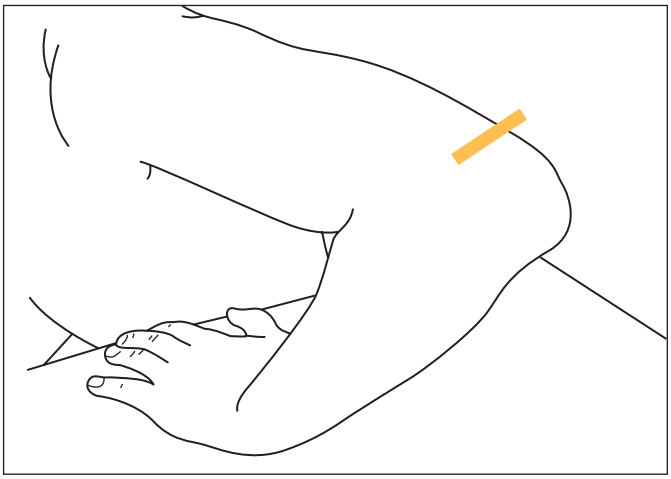

FIG. 82 TS, probe transverse to posterior elbow

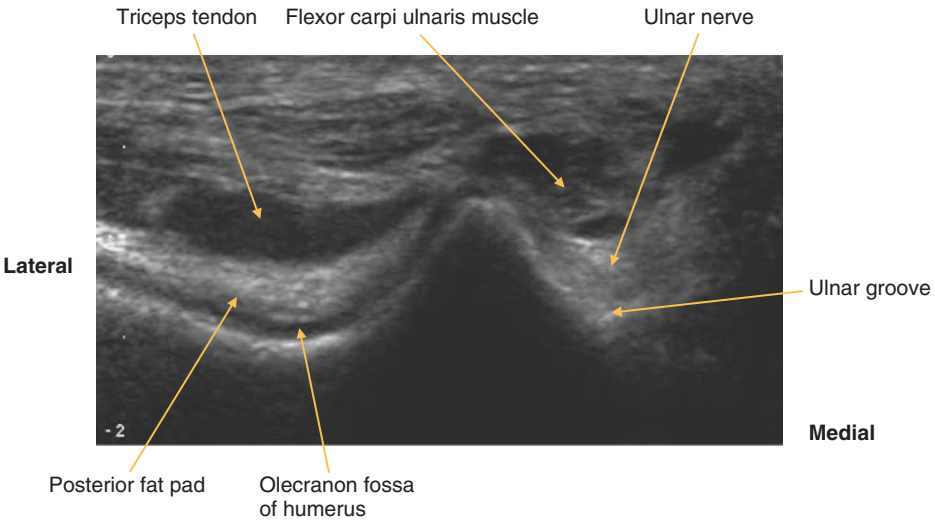

FIG. 83 TS, posterior elbow

Forearm

Anterior forearm

(Figures 84–89)

The superficial muscles arise from the CFO. They are from lateral to medial: pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, flexor carpi ulnaris.

The deep muscles include flexor pollicis longus, flexor digitorum profundus and pronator quadratus.

The course of the median nerve can be followed from elbow to wrist. It emerges from the cubital fossa, where it is medial to the brachial artery. It passes between the heads of pronator teres, and descends between flexors superficialis and profundus. At the wrist, it lies deep to the flexor retinaculum, between flexor carpi radialis and flexor digitorum superficialis.

Notes

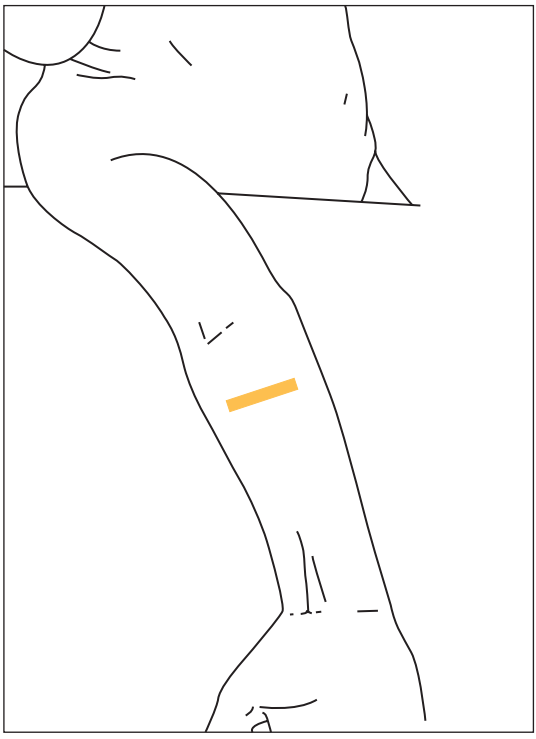

FIG. 84 TS, probe transverse on mid-forearm

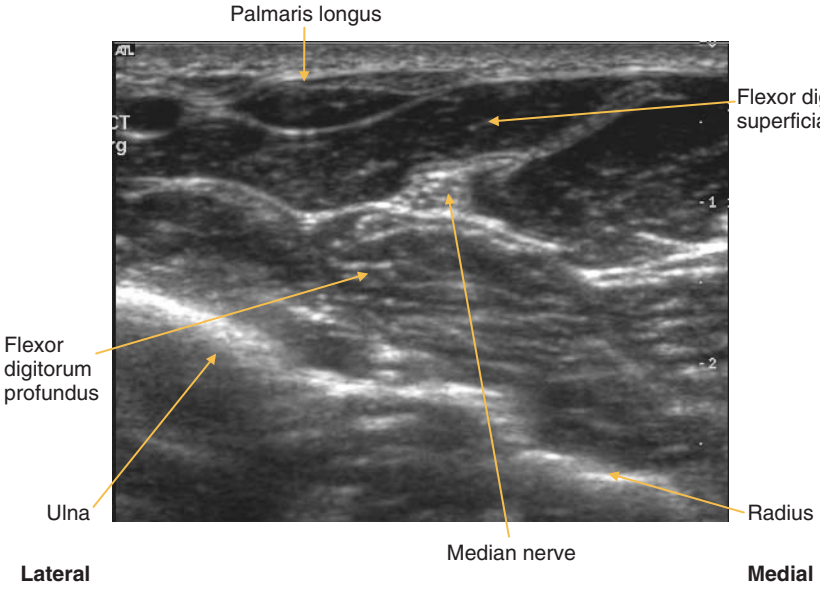

FIG. 85 TS mid-forearm

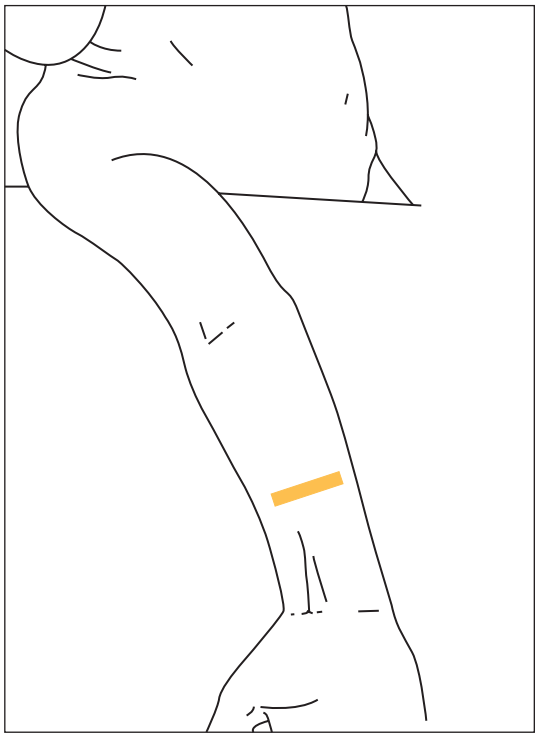

FIG. 86 TS, distal anterior forearm

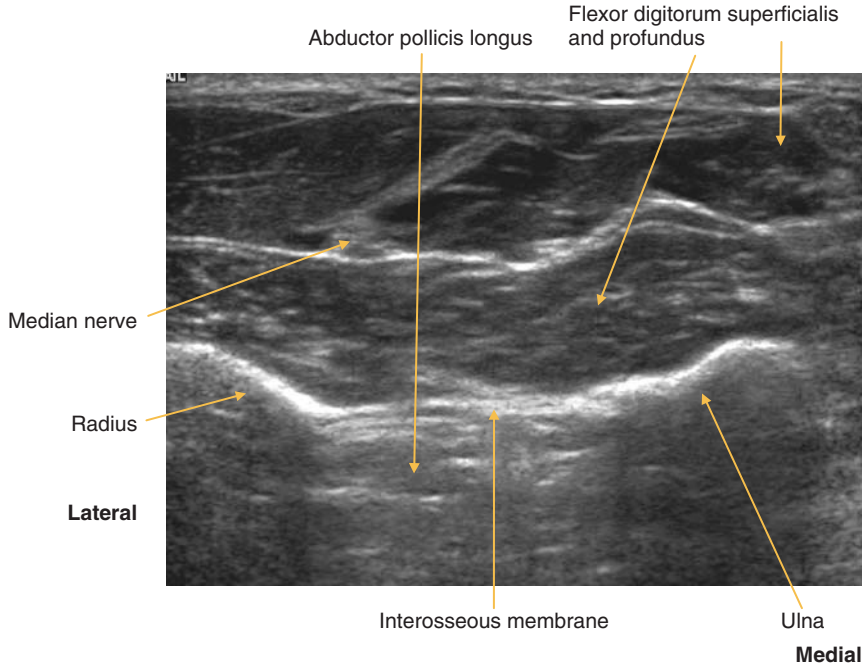

FIG. 87 TS, anterior forearm

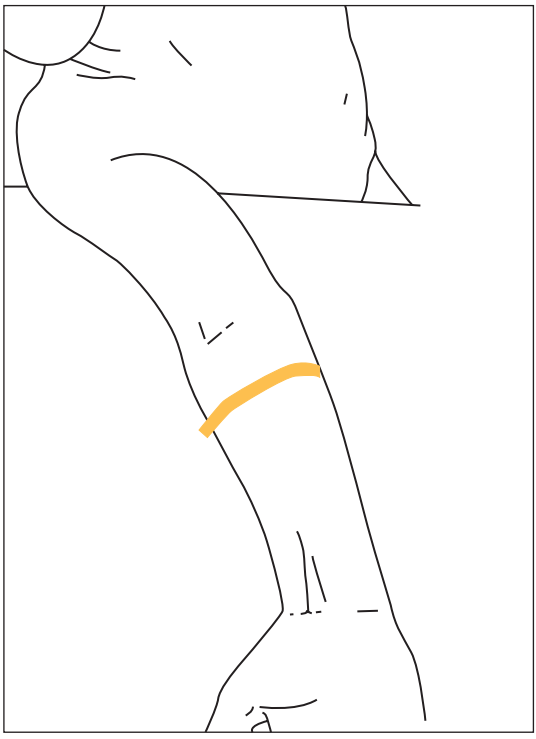

FIG. 88 TS panorama, probe transverse to forearm

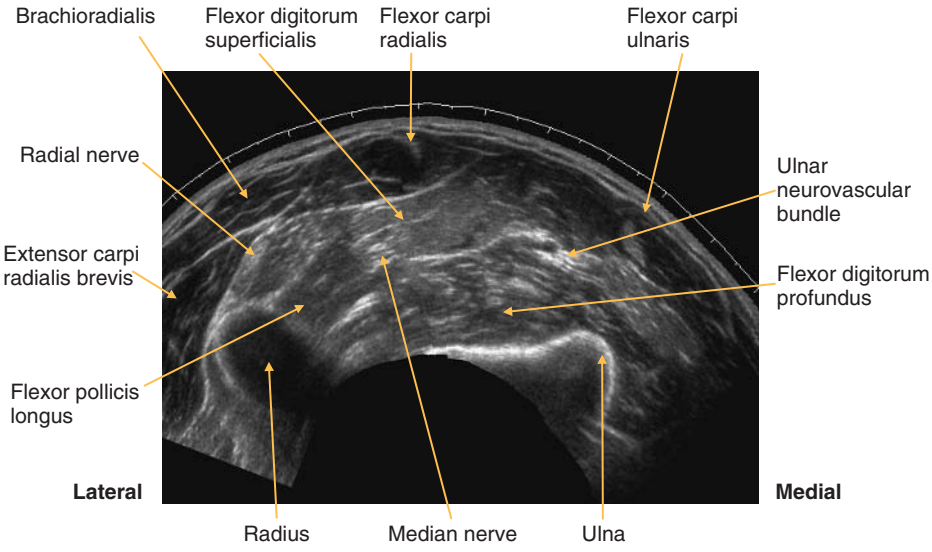

FIG. 89 TS panorama, anterior forearm

Distal forearm

(Figures 90 and 91)

Movement of the fingers helps to distinguish the median nerve from flexor tendons. It can also be followed proximally to the elbow, and no muscle belly appears. Its appearances are otherwise similar to a tendon.

Notes

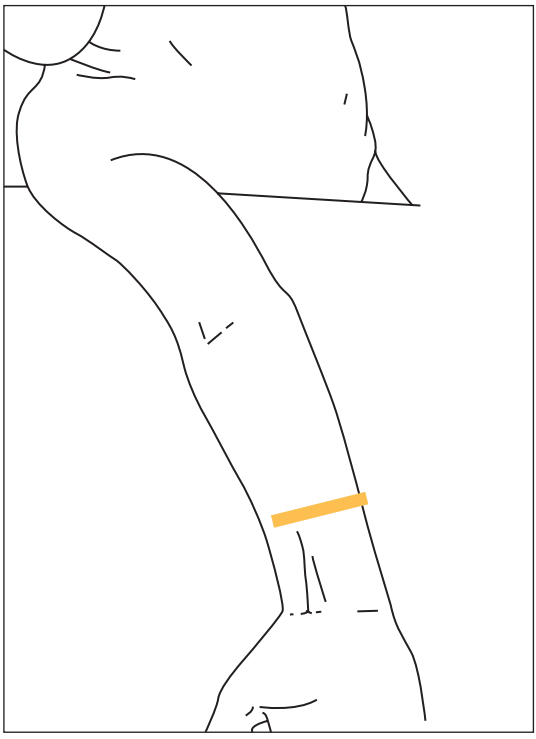

FIG. 90 TS, probe transverse to distal anterior forearm

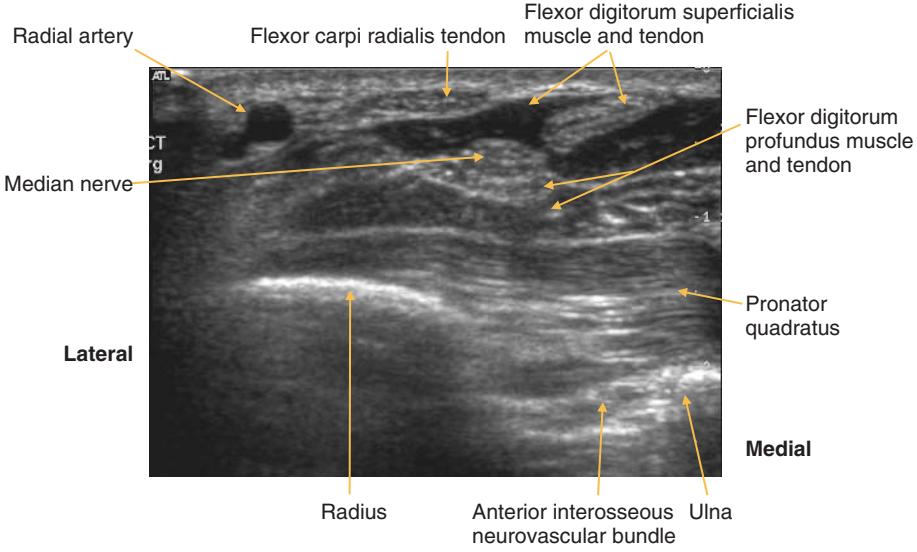

FIG. 91 TS, flexor compartment distal forearm

Posterior forearm

(Figures 92–95)

The superficial muscle group arises from the lateral supracondylar ridge of the humerus, and includes brachioradialis and extensor carpi radialis longus.

The posterior muscle group arises from the common extensor origin, and comprises extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi and extensor carpi ulnaris.

The deep muscle group includes supinator, abductor pollicis longus, extensor pollicis brevis, extensor pollicis longus and extensor indicis.

Notes

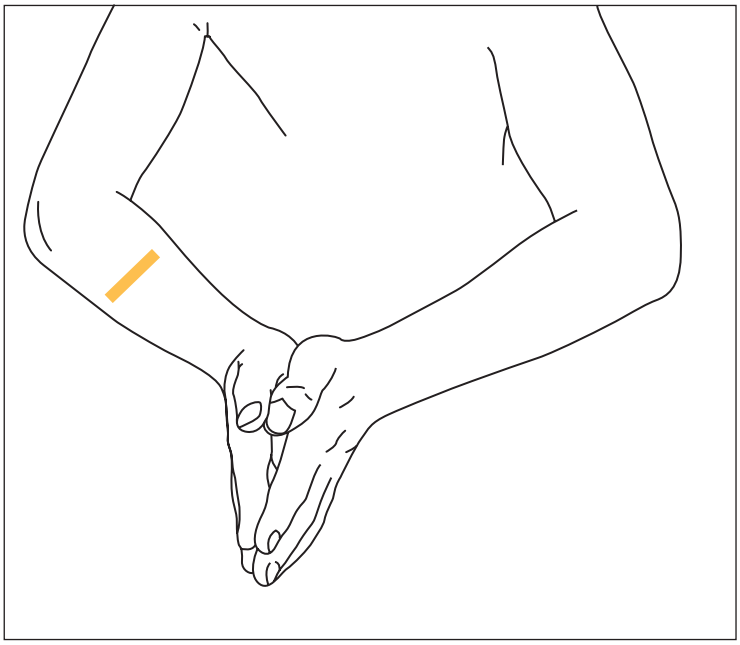

FIG. 92 TS, probe transverse to posterior forearm

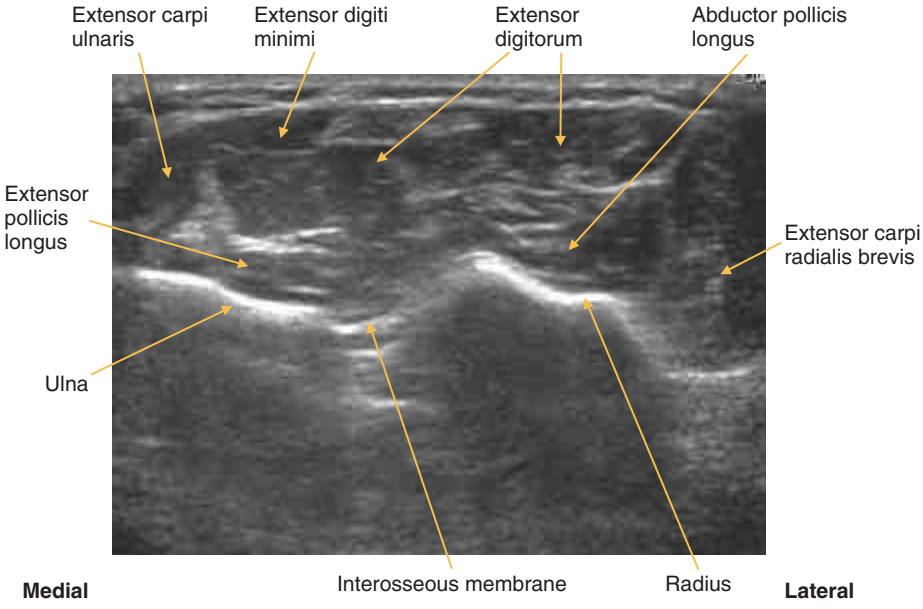

FIG. 93 TS, posterior forearm

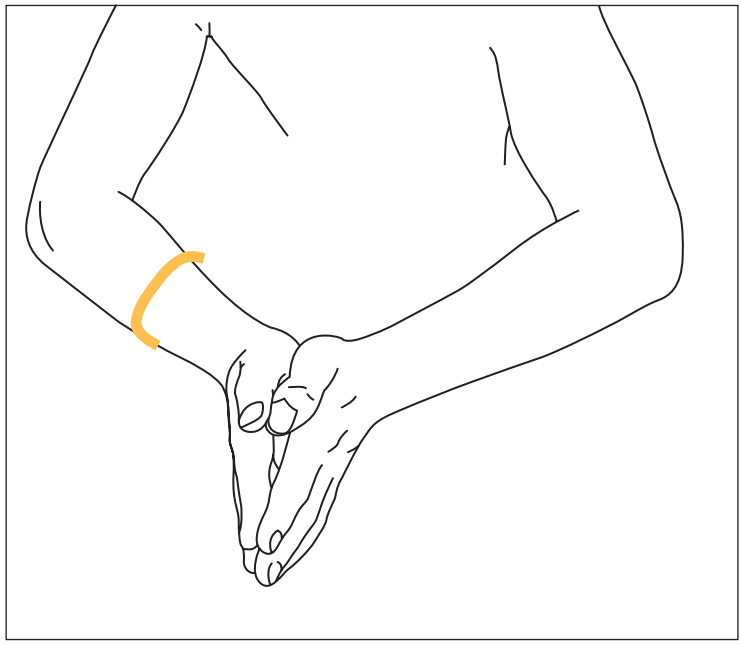

FIG. 94 TS panorama, probe transverse on posterior forearm

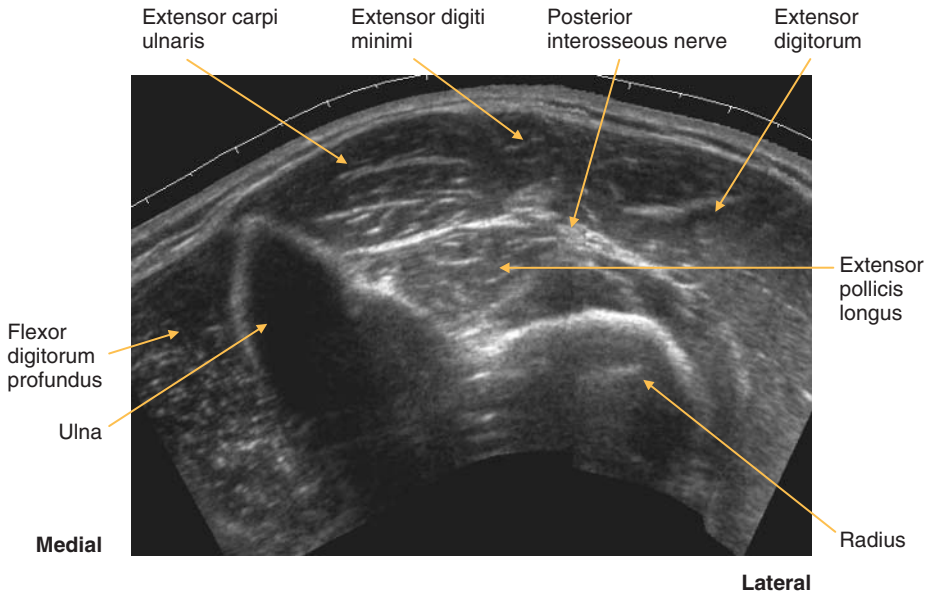

FIG. 95 TS panorama, posterior aspect of forearm

Wrist

Anterior

Carpal tunnel

(Figures 96–101)

The roof of the tunnel is formed by the flexor retinaculum, which is attached on the radial side to the tuberosity of the scaphoid and ridge of the trapezium, and on the ulnar side to the pisiform and hook of the hamate. The carpal bones form the floor.

From lateral to medial, the major contents are: flexor carpi radialis, flexor pollicis longus (deep to median nerve), flexor digitorum superficialis and profundus. Palmaris longus, if present, passes superficial to the retinaculum.

The ulnar nerve lies on the retinaculum alongside the pisiform, medial to the ulnar artery. Both are covered by a superficial part of the retinaculum, forming Guyon's canal.

Notes

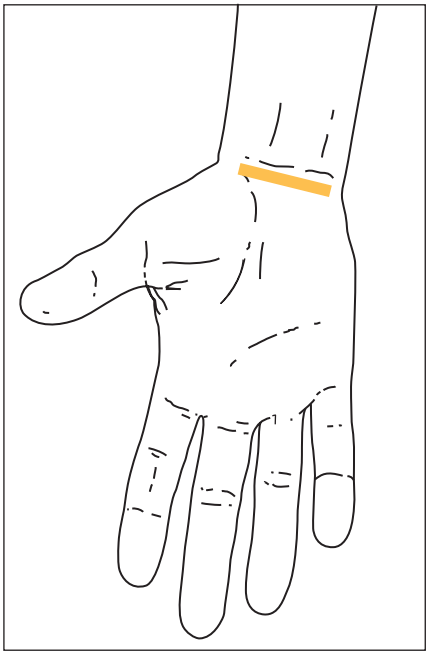

FIG. 96 TS, probe transverse to volar aspect of wrist, level of proximal carpal tunnel

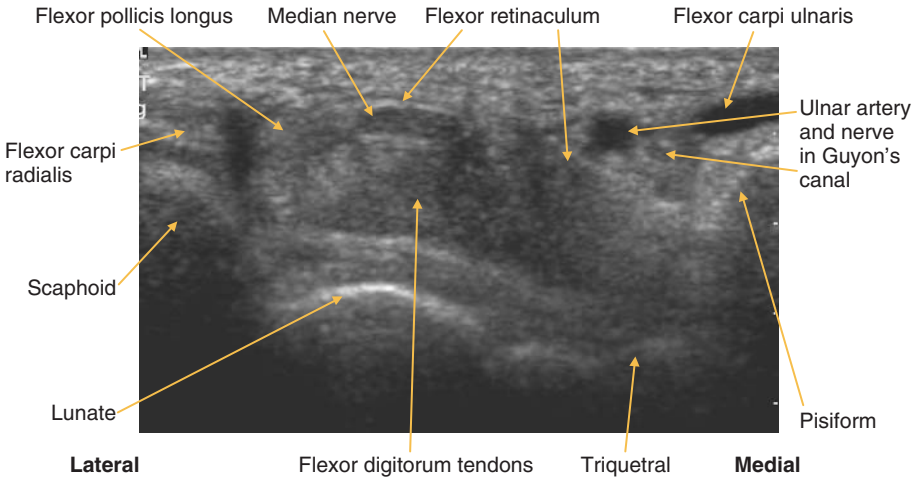

FIG. 97 TS, proximal carpal tunnel

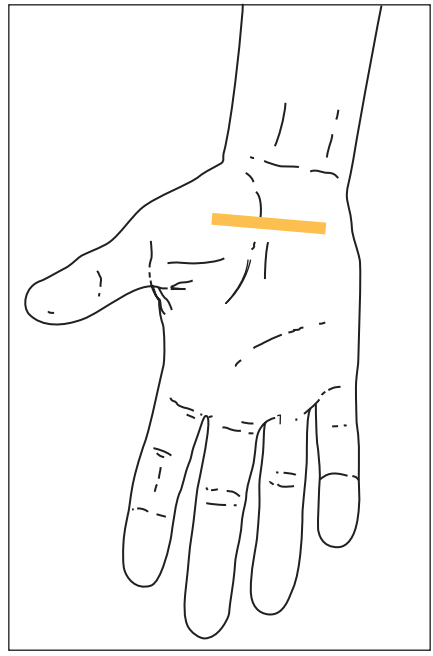

FIG. 98 TS, probe transverse to volar aspect of wrist, level of distal carpal tunnel

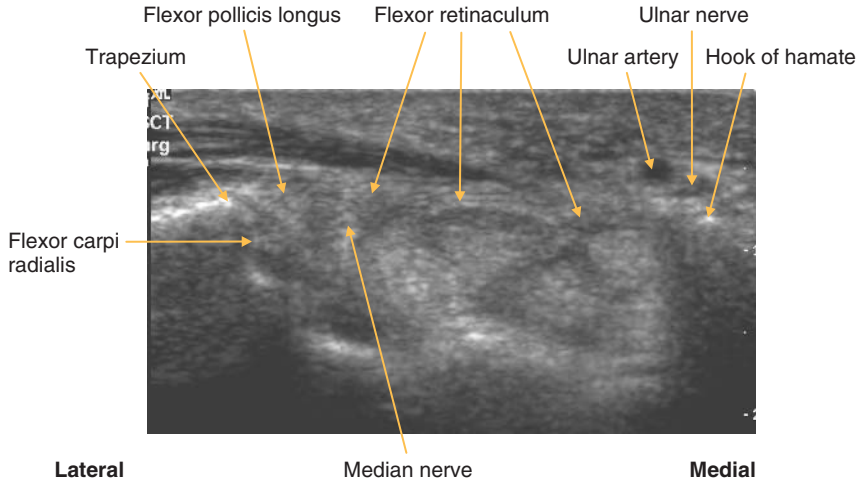

FIG. 99 TS, distal carpal tunnel

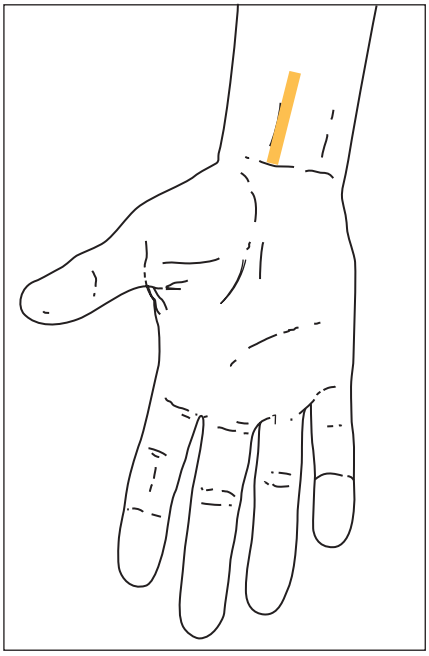

FIG. 100 LS, flexor tendons

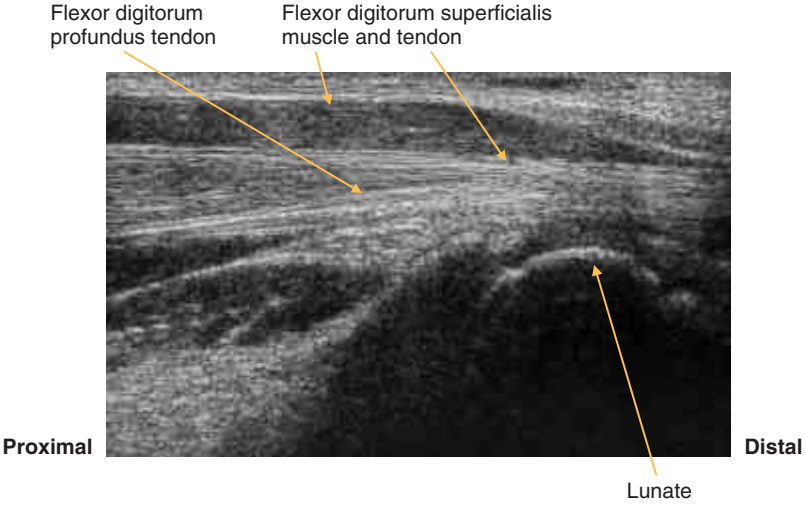

FIG. 101 LS, flexor tendons at wrist

Posterior

Anatomical snuffbox

(Figures 102–107)

Proximally, the snuffbox is demarcated by the radial styloid, and distally by the base of the thumb metacarpal. Its radial boundary is formed by two tendons (extensor pollicis brevis and abductor pollicis longus) and on the ulnar aspect by extensor pollicis longus. The floor of the snuffbox is formed by the scaphoid proximally and the trapezium distally. It contains the radial artery and cephalic vein.

Notes

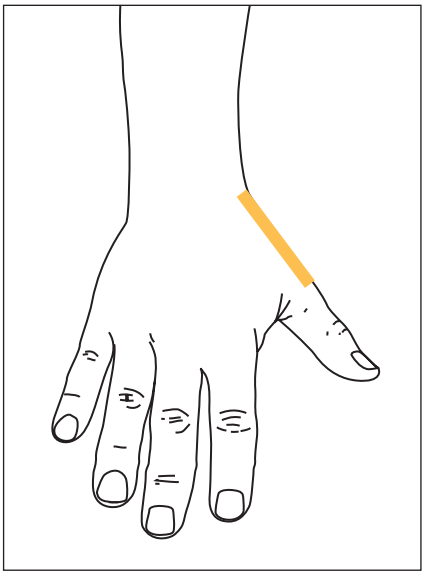

FIG. 102 LS, probe longitudinal to snuffbox, radial aspect of wrist. Ulnar deviation of the wrist with extension of the thumb

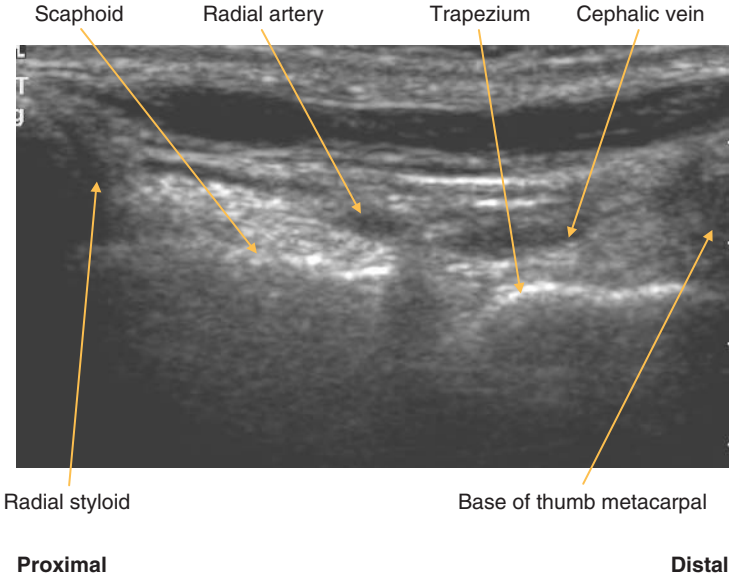

FIG. 103 LS, snuffbox

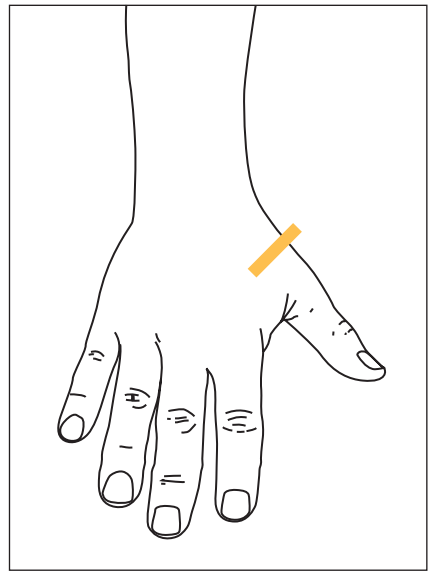

FIG. 104 TS, probe transverse to snuffbox, radial aspect of wrist. Ulnar deviation of the wrist with extension of the thumb

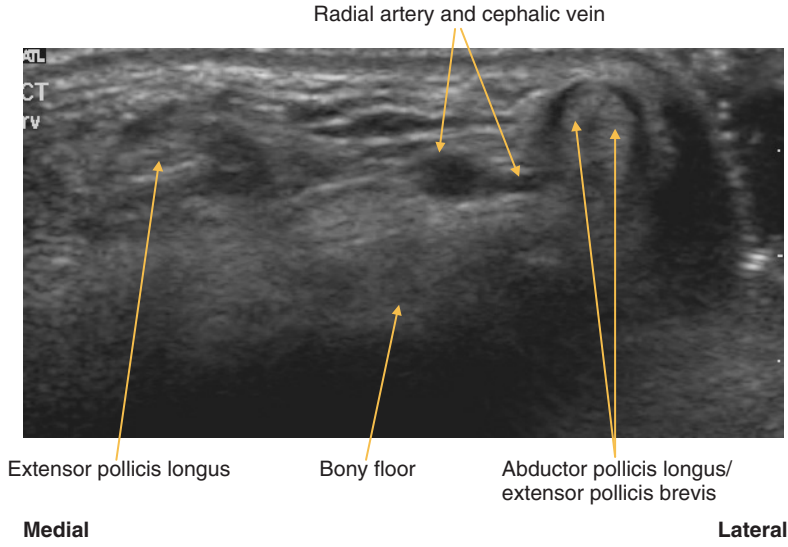

FIG. 105 TS, anatomical snuffbox

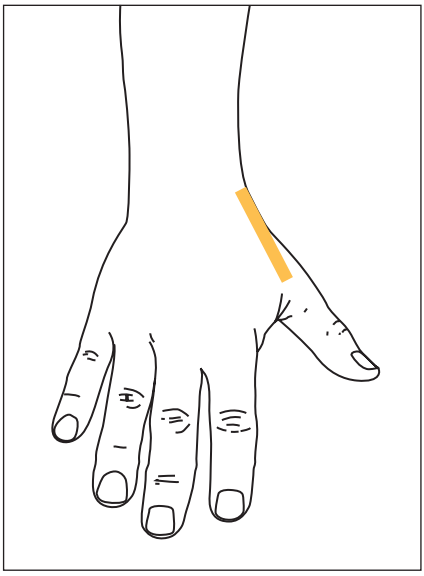

FIG. 106 LS, probe longitudinal to extensor pollicis longus tendon, radial side of wrist. Ulnar deviation of the wrist with extension of the thumb. Dynamic examination with flexion and extension of interphalangeal joint of thumb

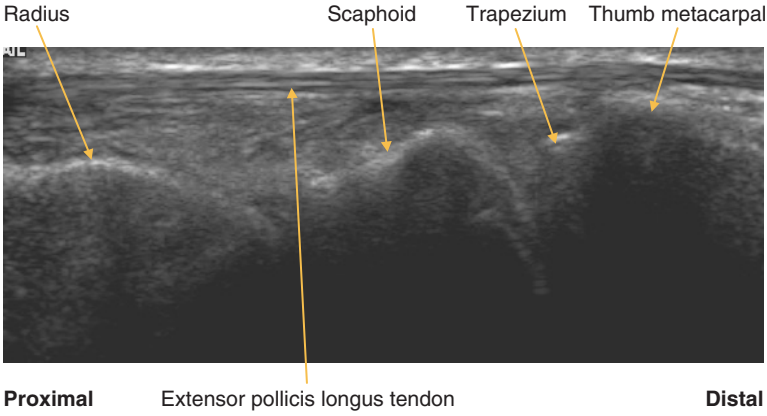

FIG. 107 LS, extensor pollicis longus tendon

Thumb carpometacarpal joint

(Figures 108 and 109)

Notes

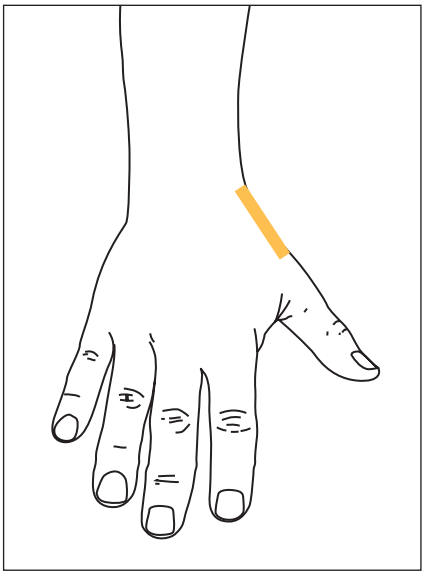

FIG. 108 LS, probe longitudinal to thumb carpometacarpal joint

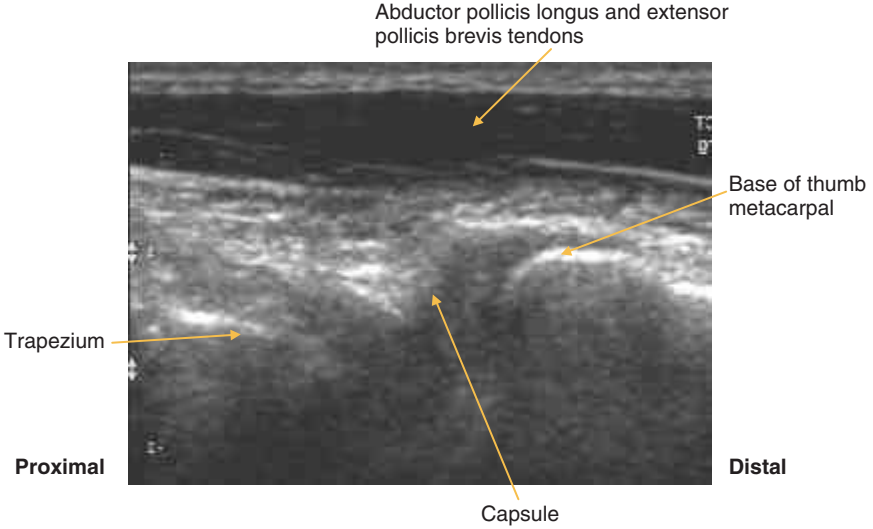

FIG. 109 LS, thumb carpometacarpal joint

Ulnar collateral ligament

(Figures 110 and 111)

Stabilizing ligament along the ulnar side of the metacarpophalangeal joint of the thumb.

Notes

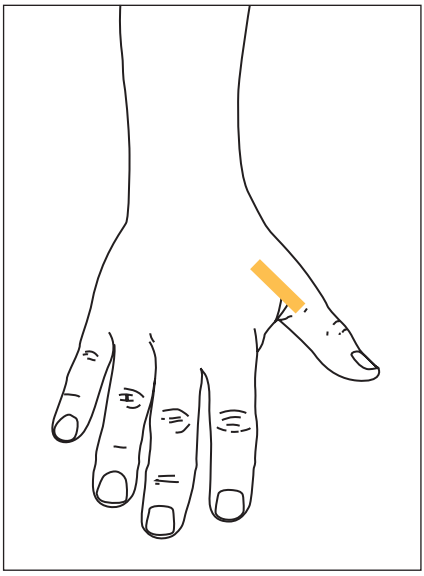

FIG. 110 LS, probe over metacarpophalangeal joint. Dynamic examination using abduction at this joint

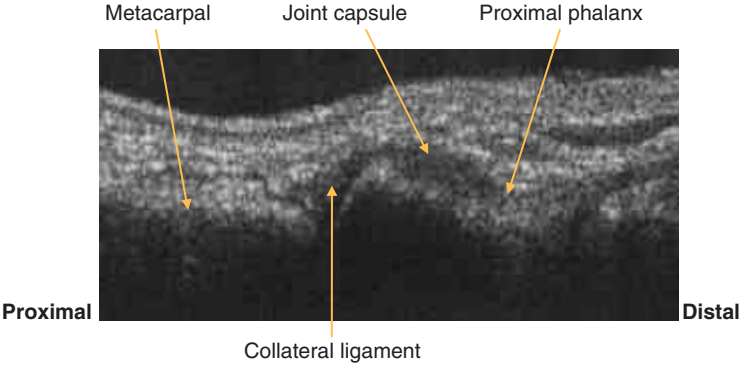

FIG. 111 LS, ulnar collateral ligament

Interosseous scapholunate ligament

(Figures 112 and 113)

The dorsal aspect of this ligament is seen as a high reflectivity linear structure in the scapholunate space.

Notes

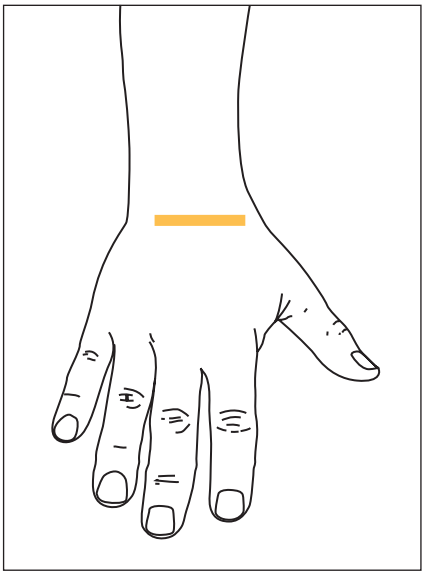

FIG. 112 TS, probe transverse to dorsal aspect of wrist, level of proximal carpal row

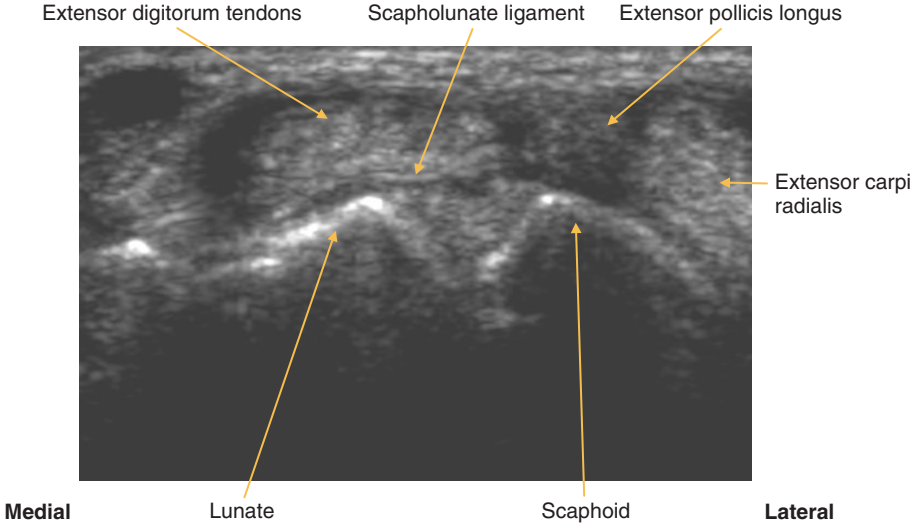

FIG. 113 TS, dorsal scapholunate ligament

Hand

Palm

Palmar spaces

(Figures 114 and 115)

The palm is divided into three spaces by two septa passing from the palmar aponeurosis to the thumb and little finger metacarpals. The lateral space contains thenar muscles; the medial contains hypothenar muscles, and the central contains long flexor tendons, lumbricals, the superficial and deep palmar arches and median nerve.

Central palmar space

Notes

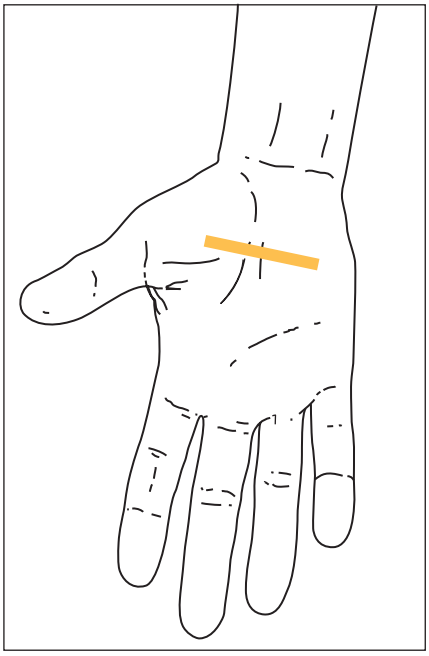

FIG. 114 TS, probe transverse to flexor tendons in proximal palm

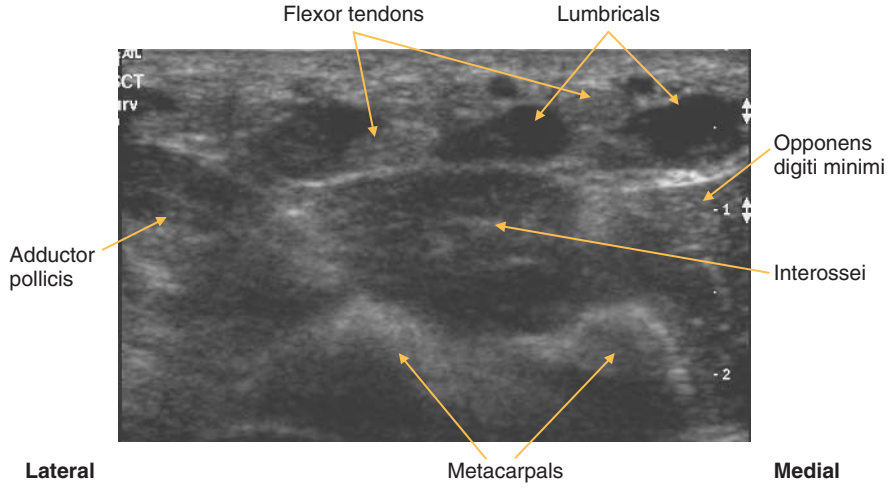

FIG. 115 TS, central palmar space

Medial (hypothenar) and lateral (thenar) palmar spaces

(Figures 116–121)

- The muscles in the hypothenar eminence are abductor digiti minimi, opponens digiti minimi and flexor digiti minimi.
- The muscles in the thenar eminence are abductor pollicis brevis, opponens pollicis and flexor pollicis brevis.

Notes

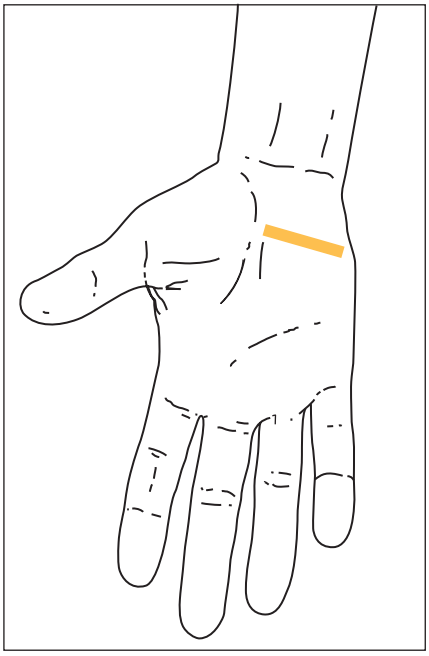

FIG. 116 TS, probe transverse on hypothenar eminence

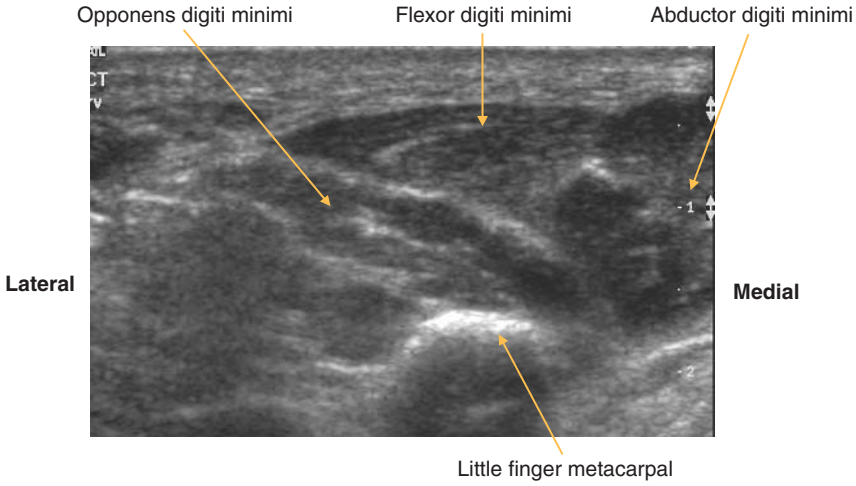

FIG. 117 TS, hypothenar eminence

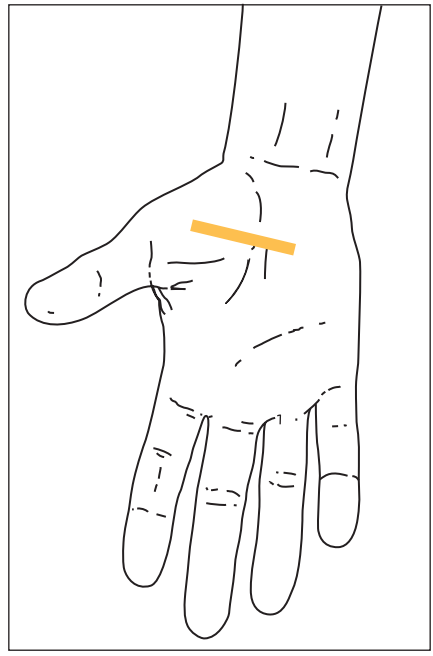

FIG. 118 TS, probe on thenar eminence

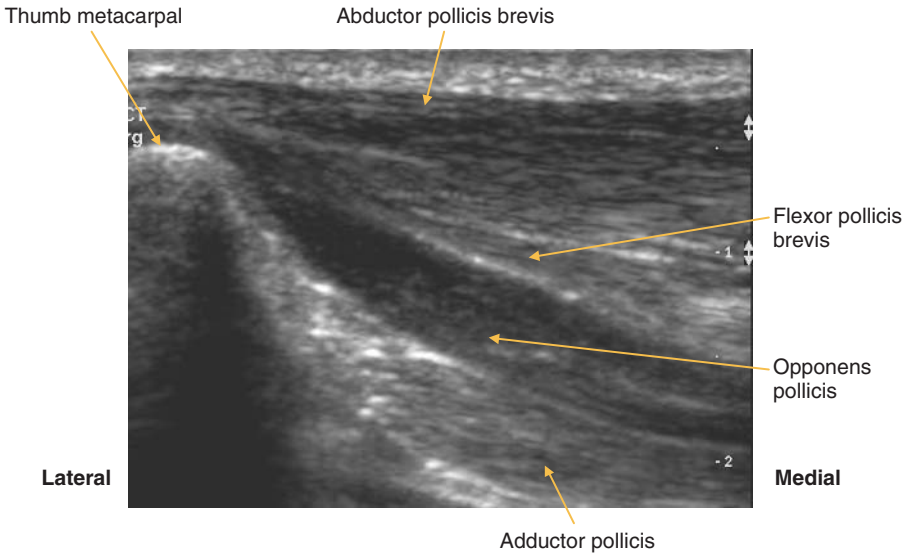

FIG. 119 TS, thenar eminence

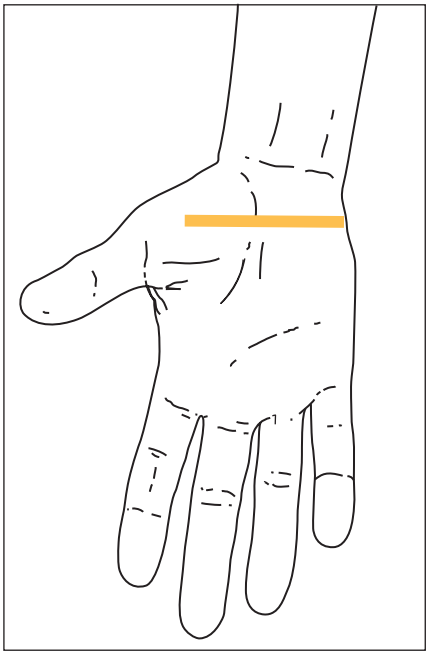

FIG. 120 TS panorama, thenar and hypothenar eminences

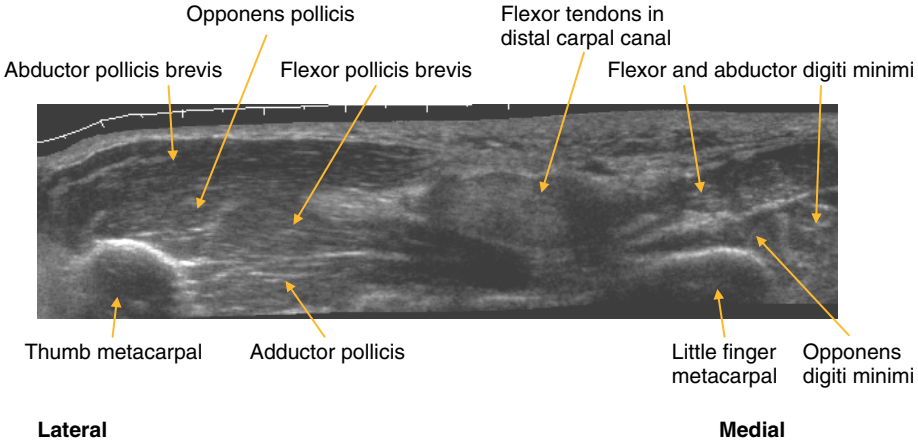

FIG. 121 TS panorama, palmar spaces

Flexor tendons

(Figures 122–138)

The superficial flexor tendons pass deep to the flexor retinaculum at the wrist. In the palm they are contained within a common flexor sheath, superficial to the profundus tendons. This relationship continues in the common synovial sheath of the finger. The superficialis tendon splits at the level of the proximal phalanx, and is pierced by the profundus tendon, which is therefore the most superficial tendon at the distal part of the proximal phalanx. The superficial tendon inserts onto the sides of the palmar surface of the middle phalanx, and the deep tendon continues to the base of the distal phalanx.

Notes

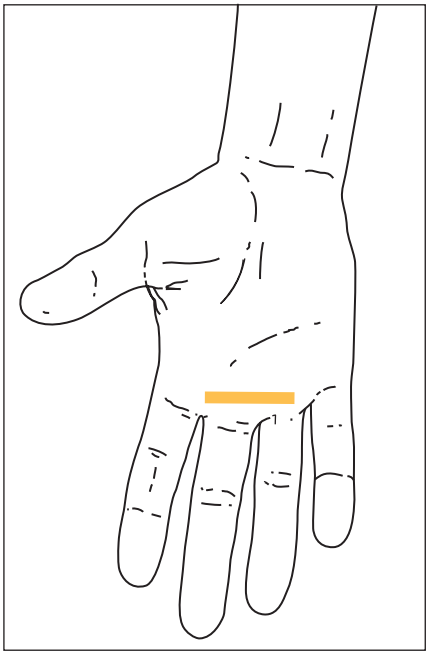

FIG. 122 TS, probe transverse to flexor tendons, distal palm

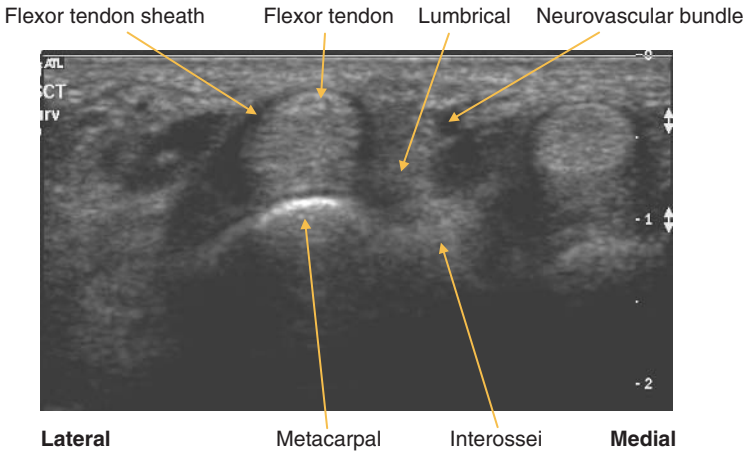

FIG. 123 TS, flexor tendons

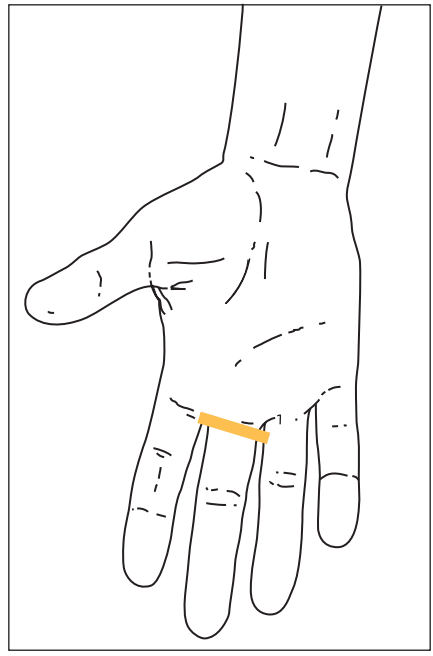

FIG. 124 TS, probe over proximal phalanx

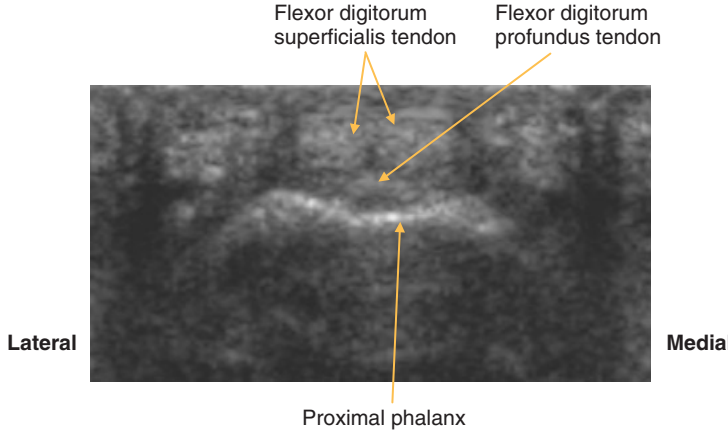

FIG. 125 TS, flexor tendon, level of proximal phalanx

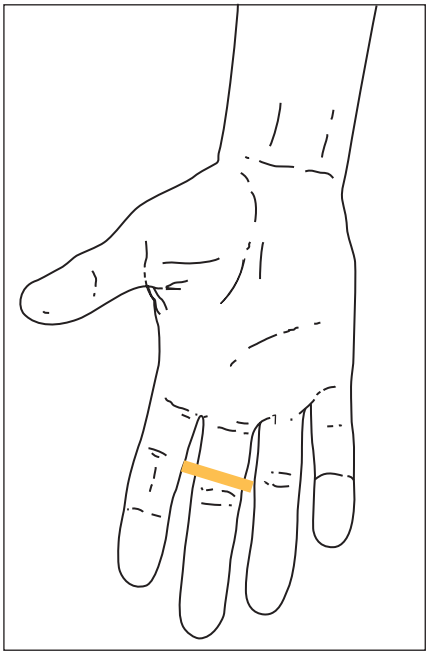

FIG. 126 TS, level of distal proximal phalanx

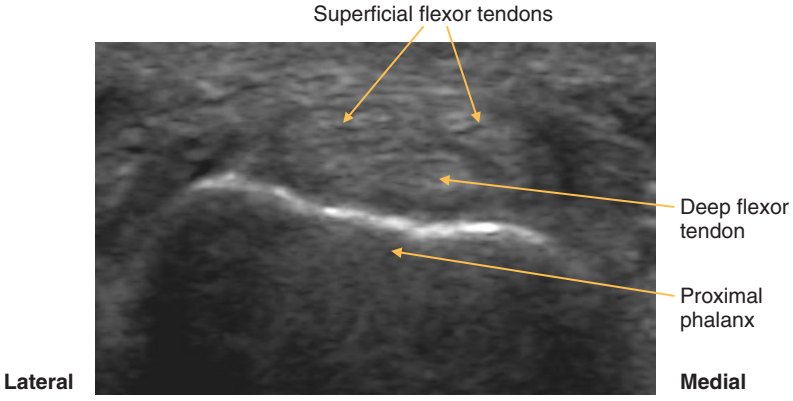

FIG. 127 TS of finger flexor tendons, level of proximal phalanx

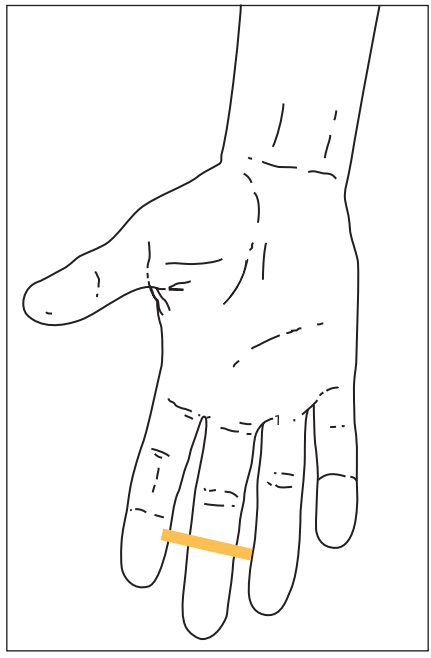

FIG. 128 TS, level of middle phalanx

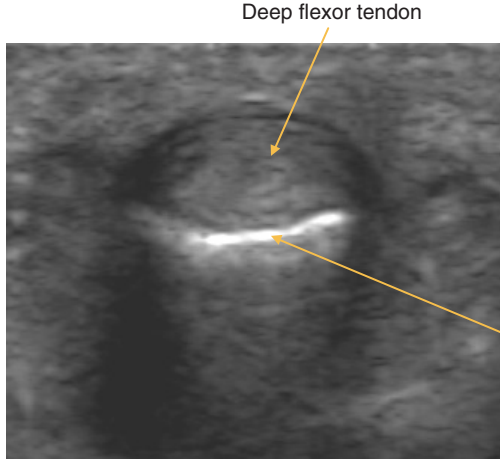

FIG. 129 TS, finger flexor tendon, level of middle phalanx

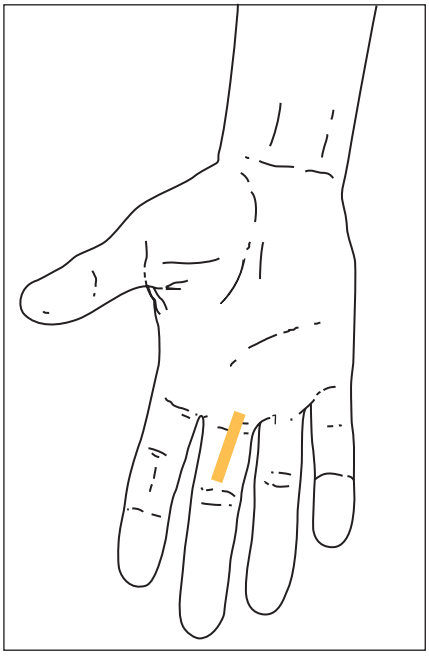

FIG. 130 LS, probe longitudinal to flexor tendons, level of metacarpophalangeal joint. Dynamic assessment with finger flexion and extension

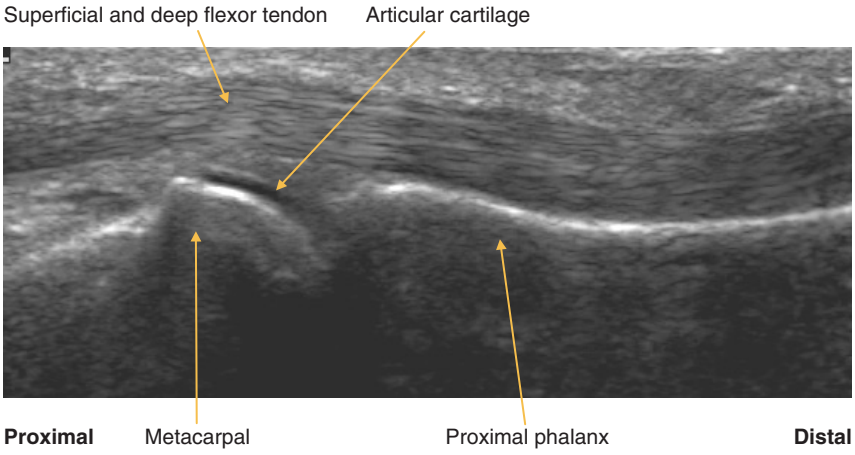

FIG. 131 LS, finger flexor tendon

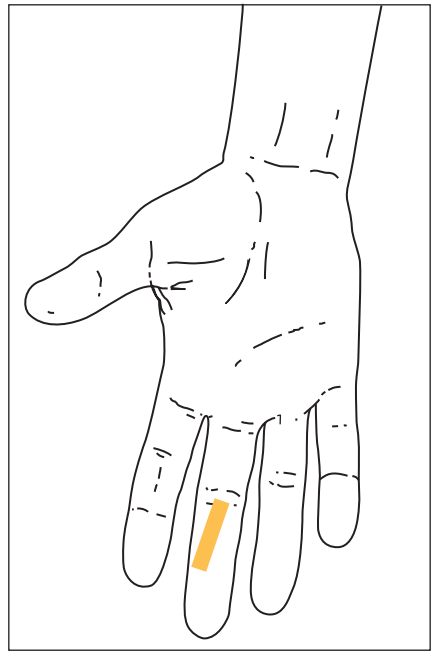

FIG. 132 LS, probe longitudinal to proximal interphalangeal joint

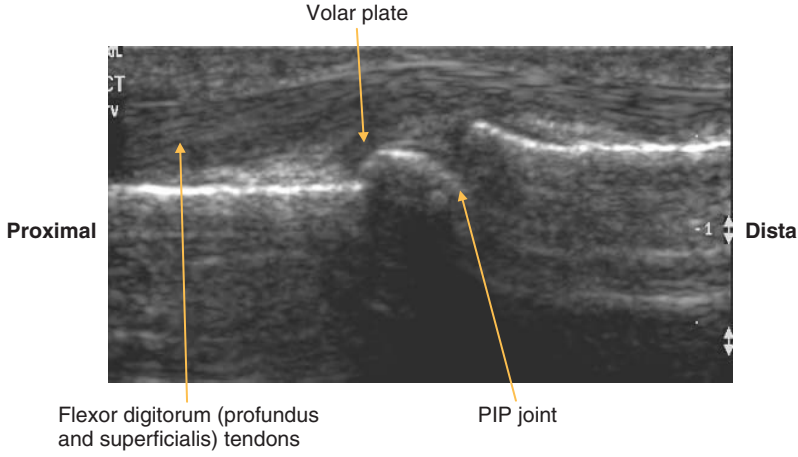

FIG. 133 LS, flexor tendon

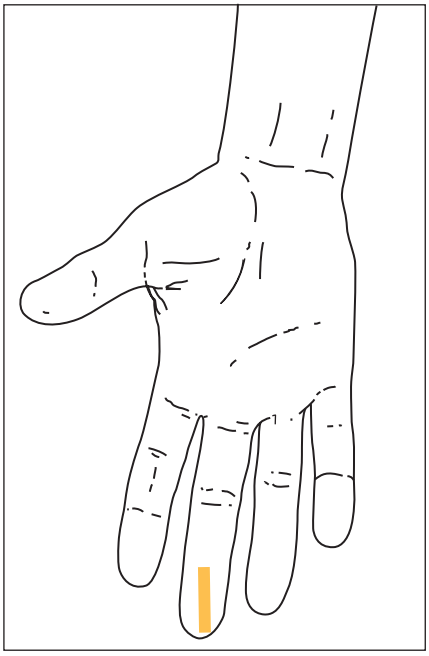

FIG. 134 LS, probe longitudinal to distal interphalangeal joint

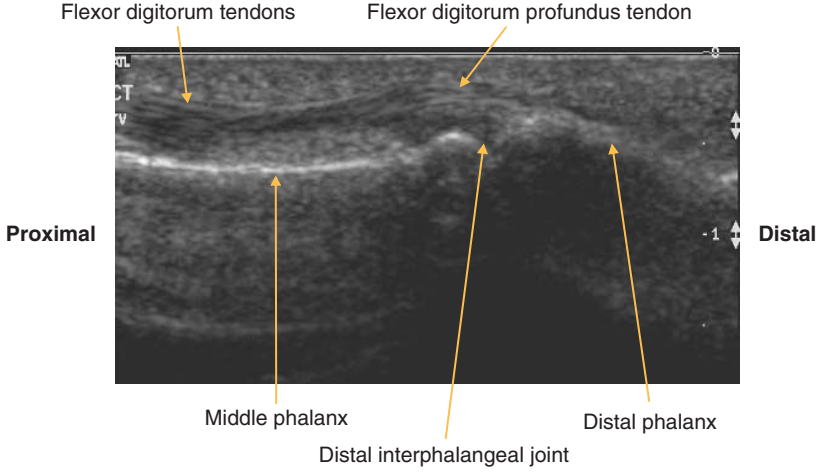

FIG. 135 LS, finger

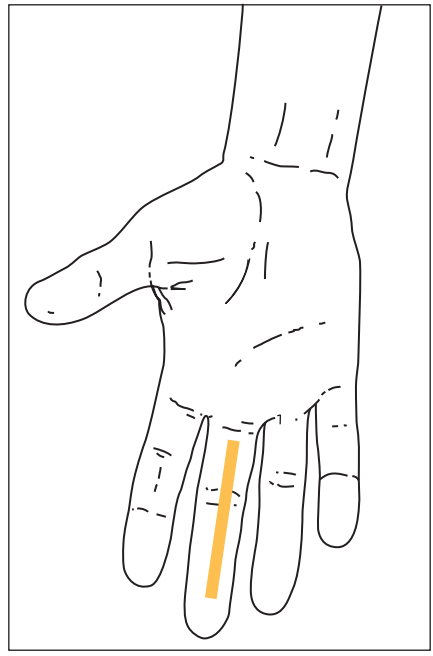

FIG. 136 LS panorama, finger flexors

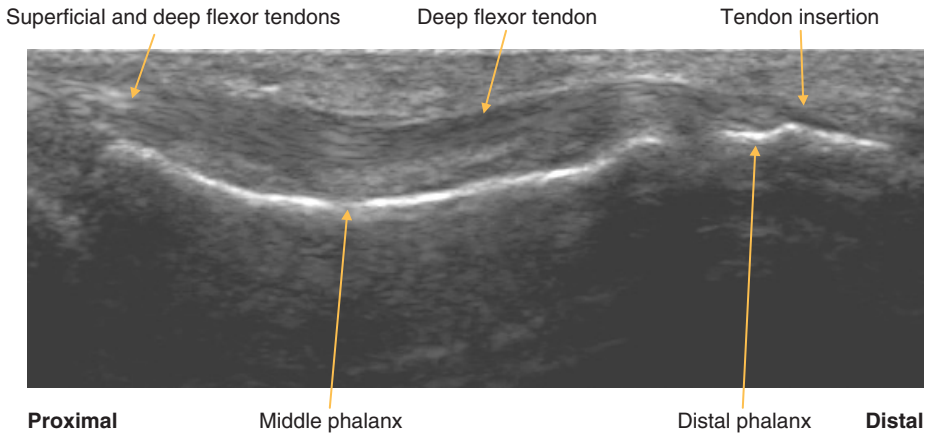

FIG. 137 LS panorama, flexor digitorum profundus insertion

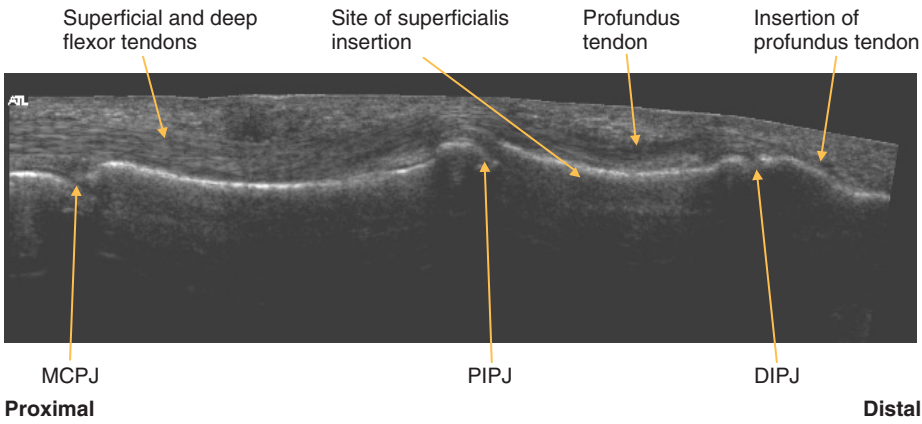

FIG. 138 Panorama, flexor digitorum tendons

Dorsum of the hand

(Figures 139–141)

Notes

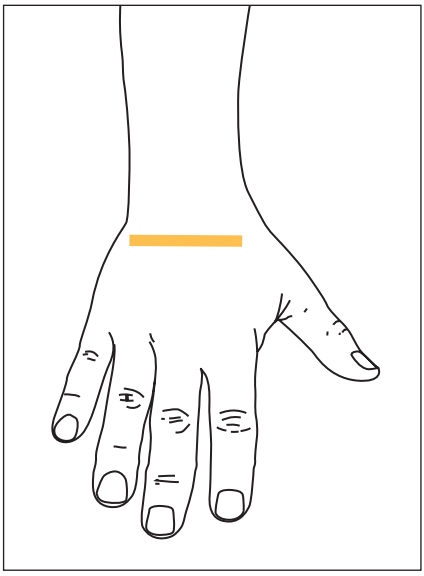

FIG. 139 TS, probe transverse on dorsum of hand

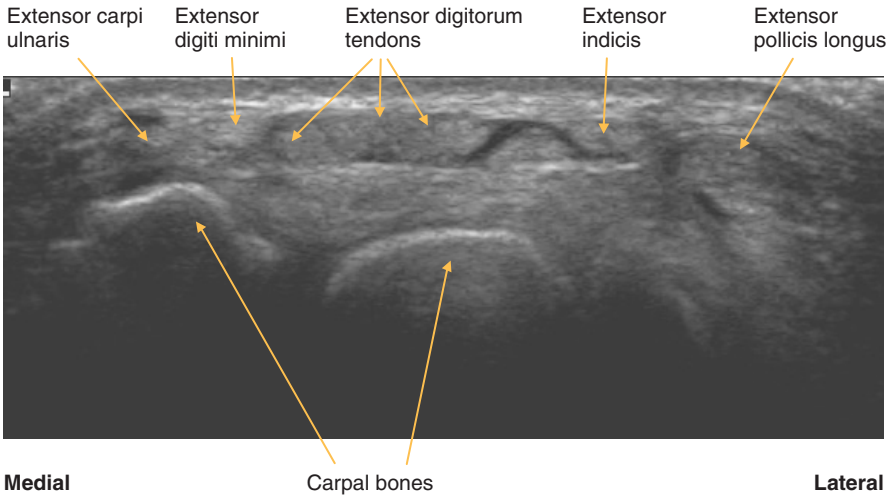

FIG. 140 TS, dorsum of hand

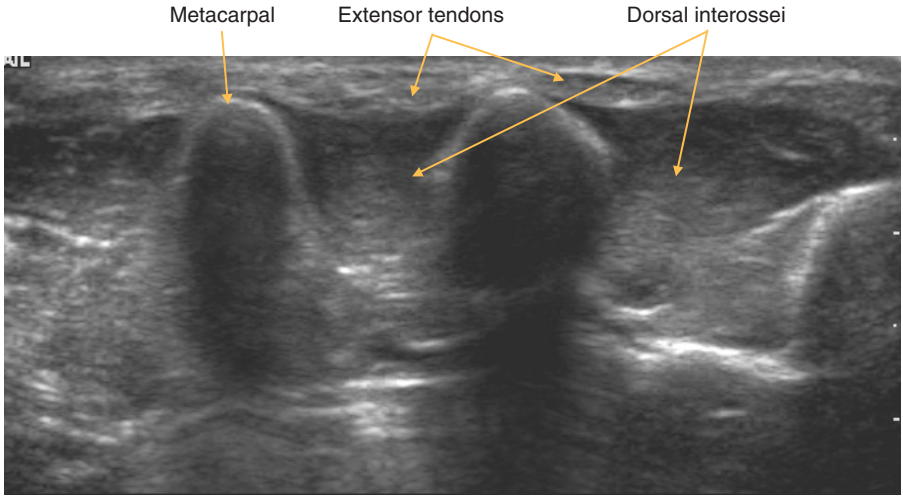

FIG. 141 TS mid dorsum of hand

Abdomen and pelvis

Anterior wall 116
Posterior wall 126
Groin 134
Hip 146

Anterior wall

(Figures 142–155)

- Rectus sheath
  - Aponeurosis of three muscles (external oblique, internal oblique, transversus abdominis) to form linea alba in midline.
- Proximal attachment
  - Costal margin, xiphisternum.
- Distal attachment
  - Pubic symphysis and crest.

Notes

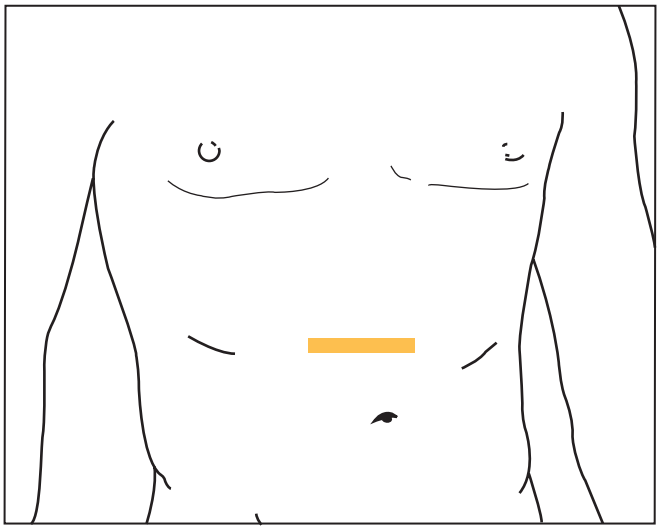

FIG. 142 TS, midline

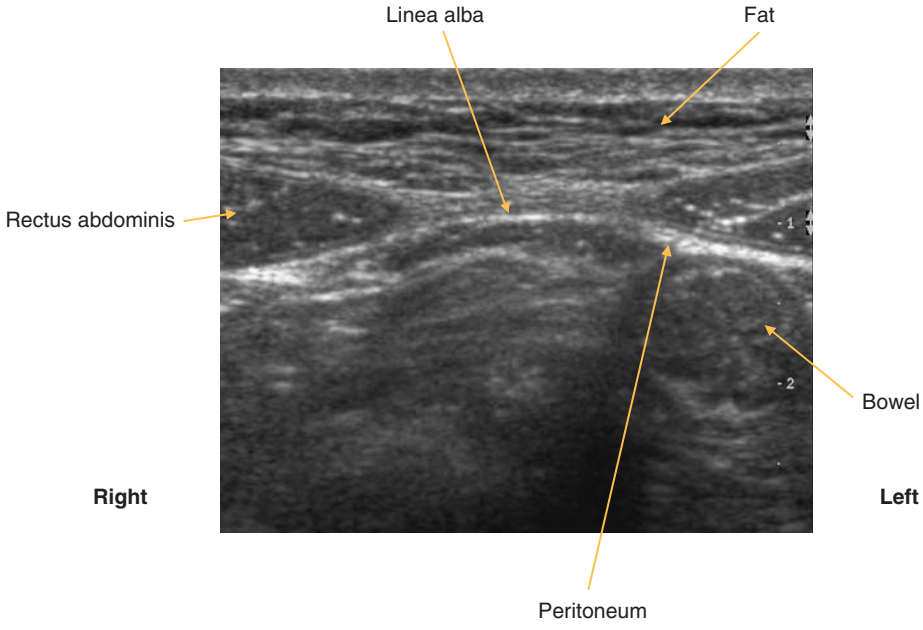

FIG. 143 TS, rectus sheath – mid-abdomen

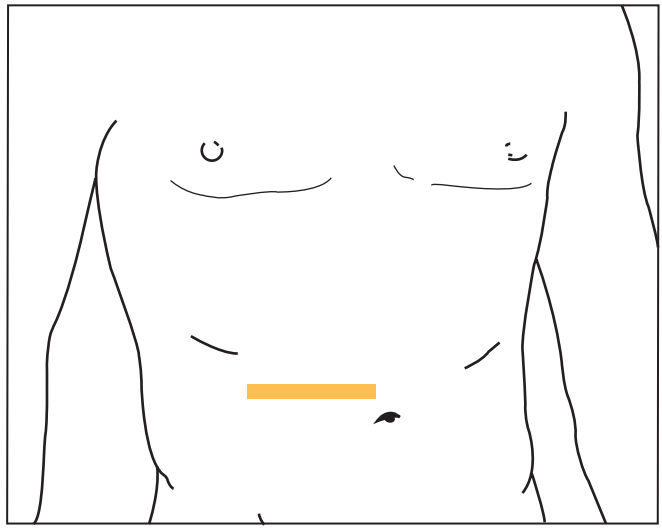

FIG. 144 TS, probe right of midline

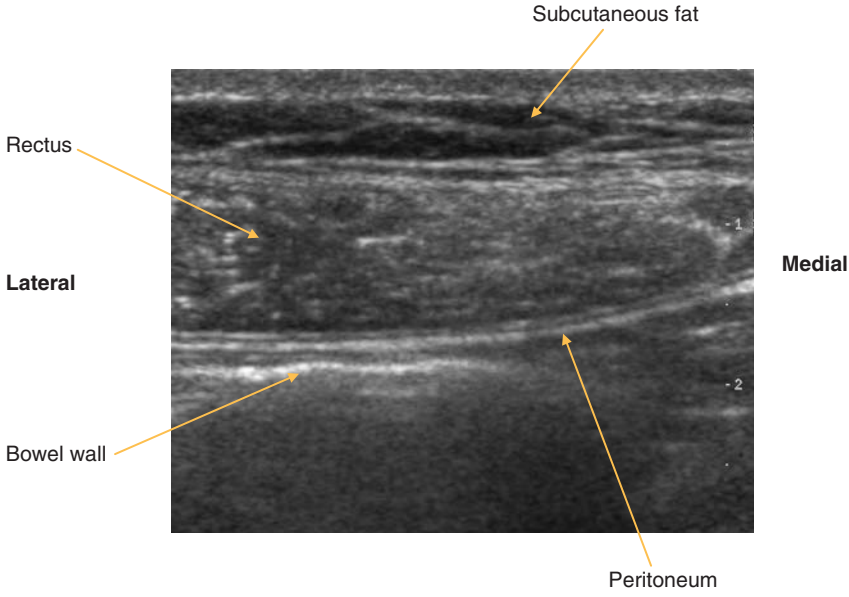

FIG. 145 TS, rectus abdominis

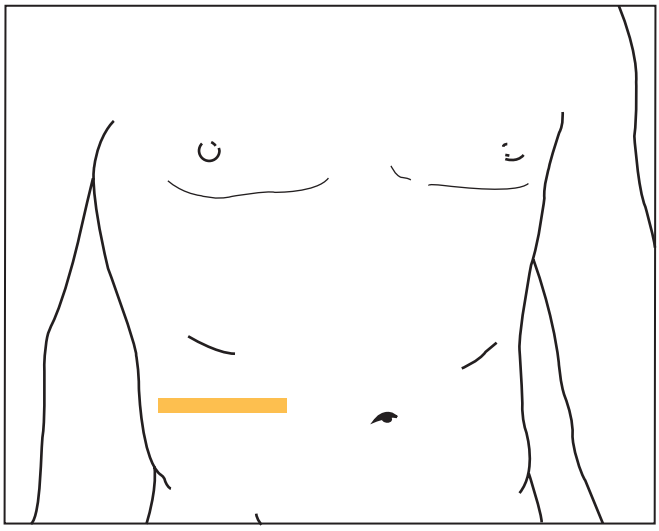

FIG. 146 TS, probe over flank/anterior wall

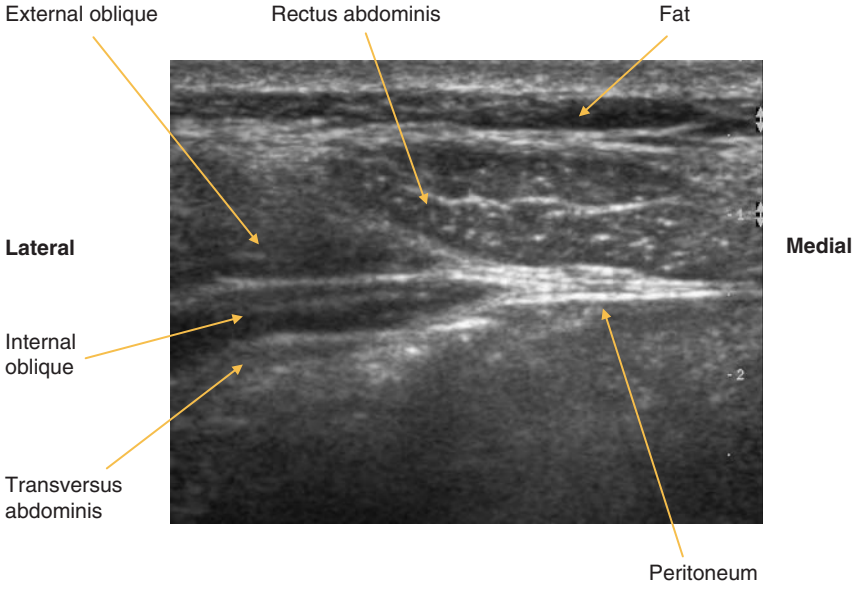

FIG. 147 TS, anterior abdominal wall – mid-abdomen

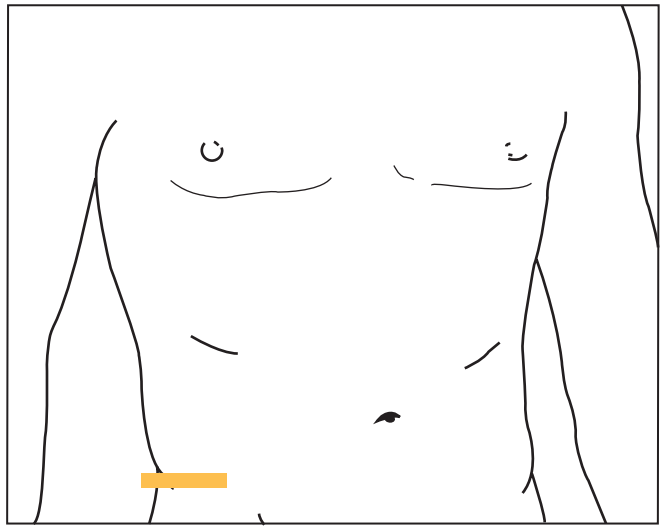

FIG. 148 TS, probe over flank

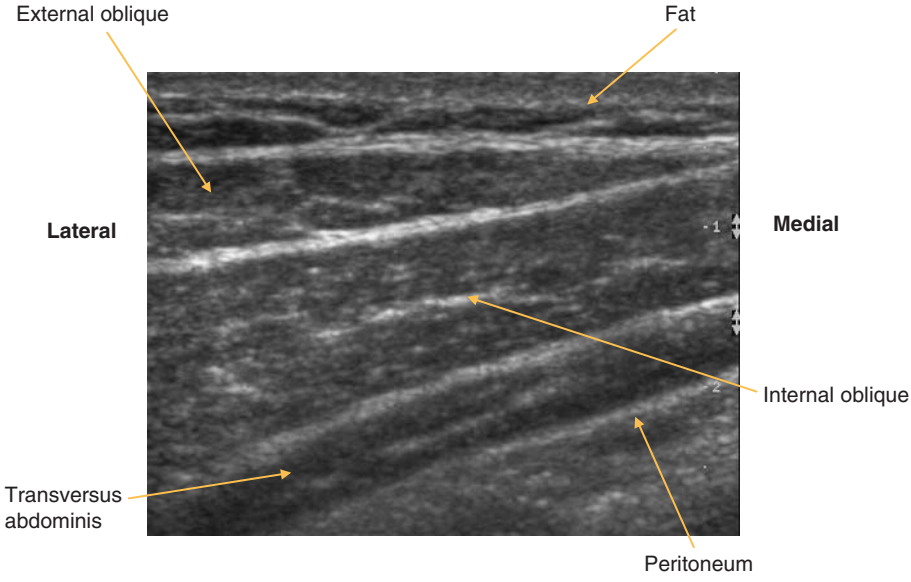

FIG. 149 TS, anterior abdominal wall – flank

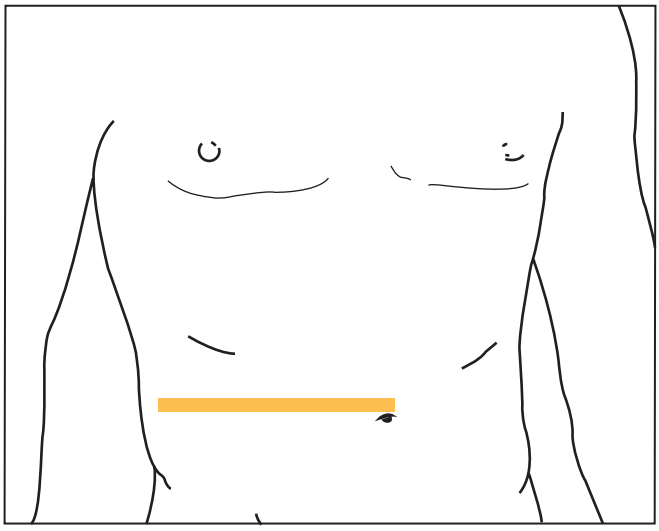

FIG. 150 TS panorama, rectus sheath

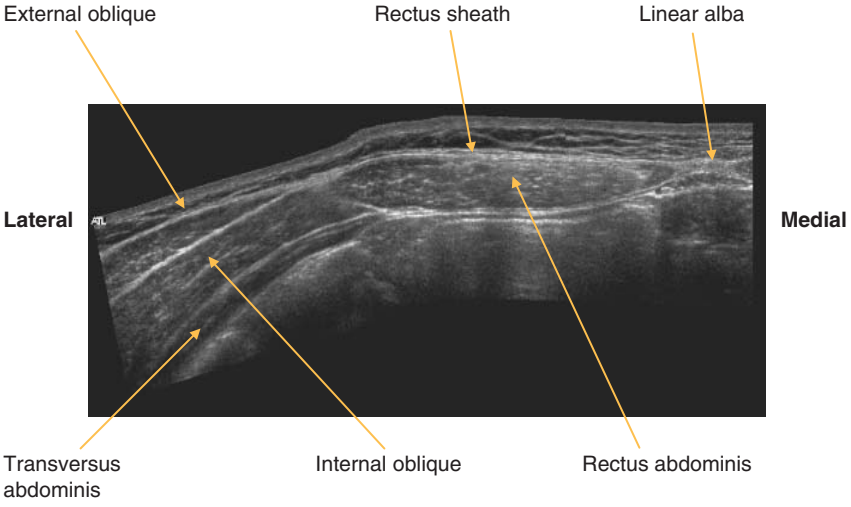

FIG. 151 TS panorama, anterior abdominal wall

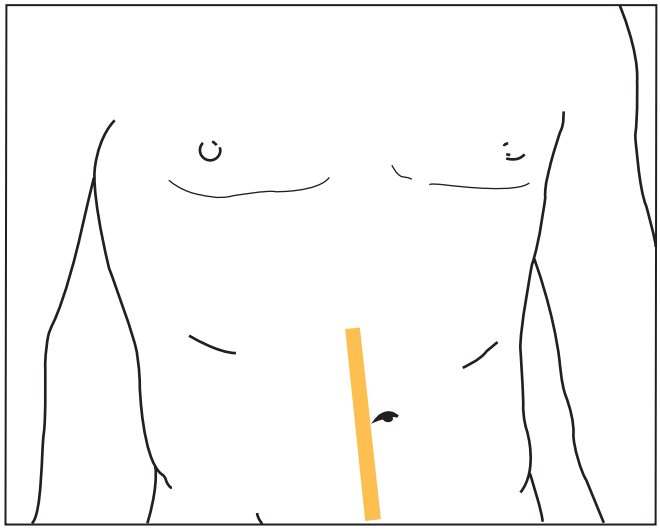

FIG. 152 LS panorama, right of midline

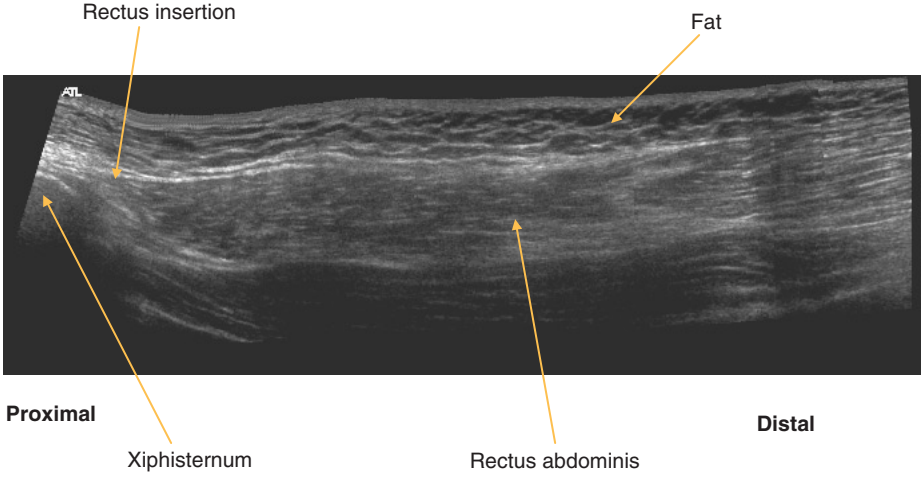

FIG. 153 LS panorama, rectus origin from xiphisternum

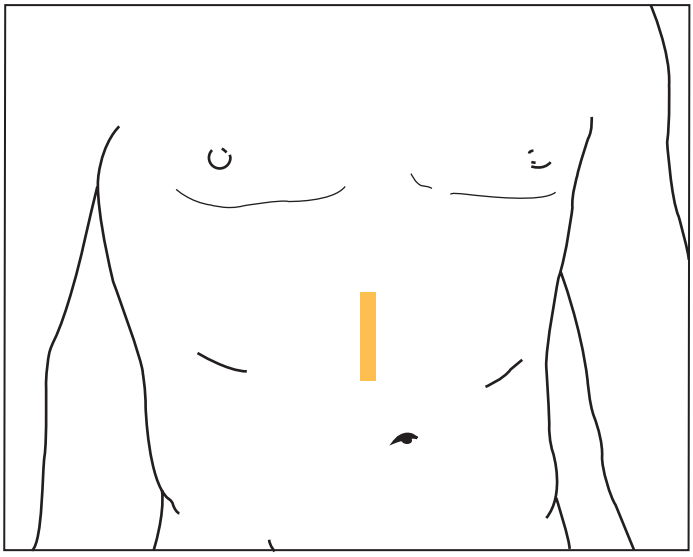

FIG. 154 LS, probe over xiphisternum. Proximal insertion is normally ill defined and appearance of xiphisternum depends on the degree of calcification

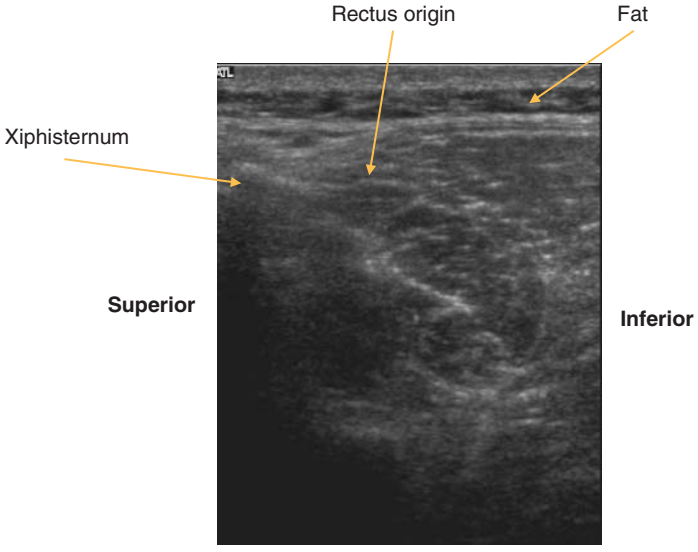

FIG. 155 LS, rectus origin

Distal rectus insertion

(Figures 156 and 157)

Notes

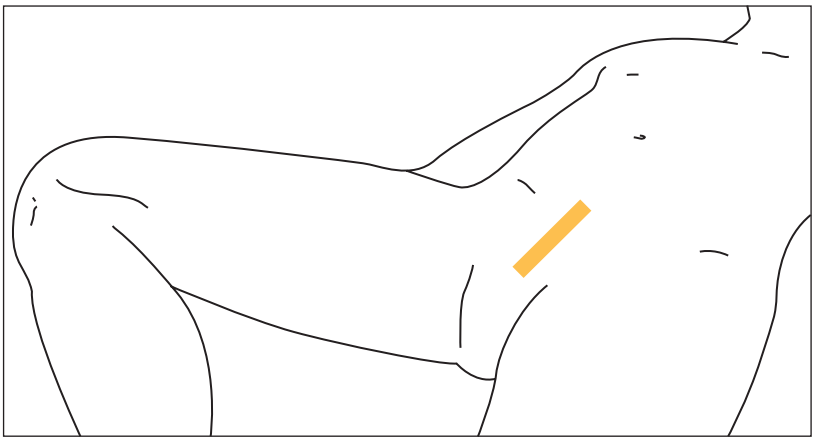

FIG. 156 LS, probe over symphysis

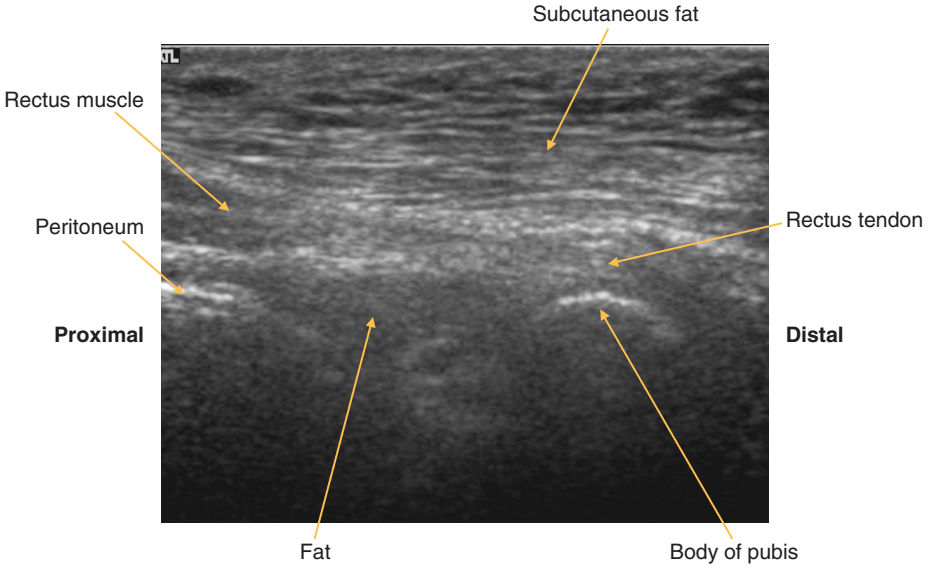

FIG. 157 LS, distal rectus insertion

Posterior wall

(Figures 158–169)

Thoracolumbar fascia – encloses muscles of posterior wall (erector spinae, latissimus dorsi, quadratus lumborum). Consists of three layers which fuse laterally with internal oblique and transversalis.

Notes

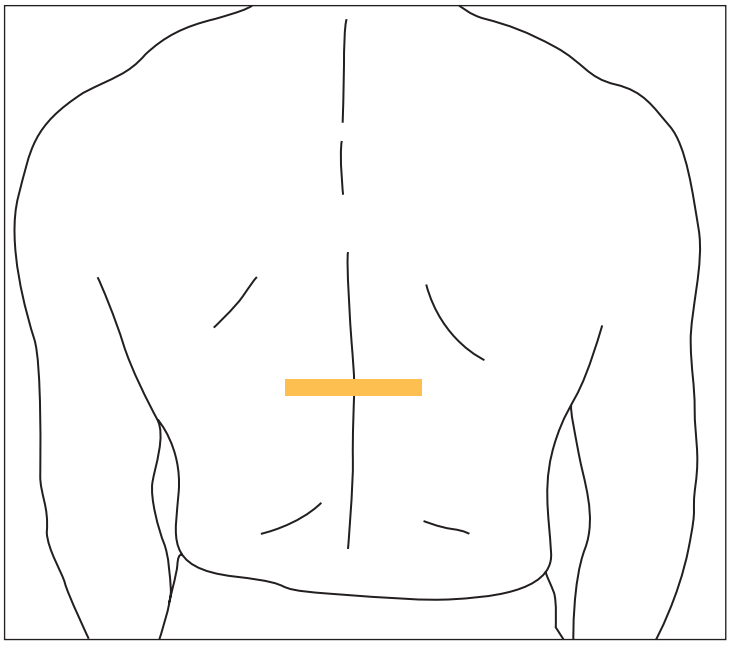

FIG. 158 TS, probe upper lumbar area midline

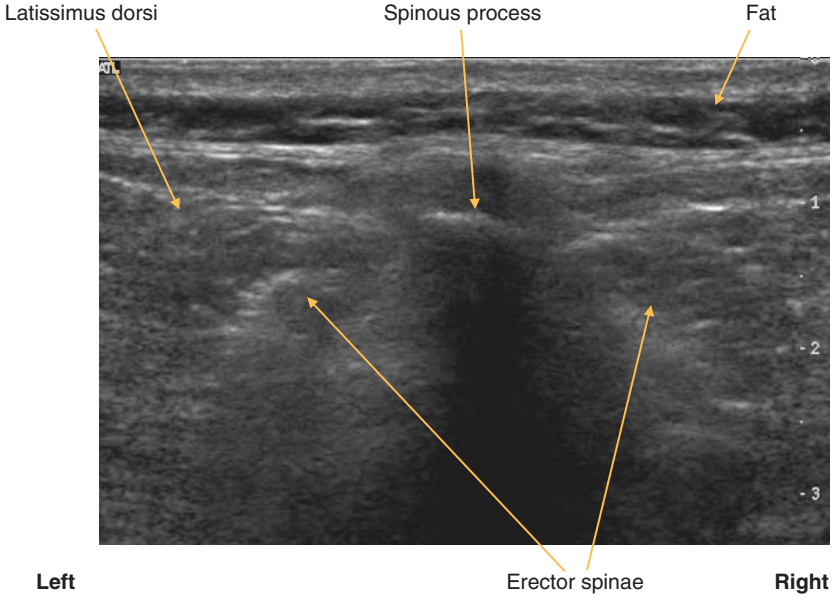

FIG. 159 TS, midline lumbar region

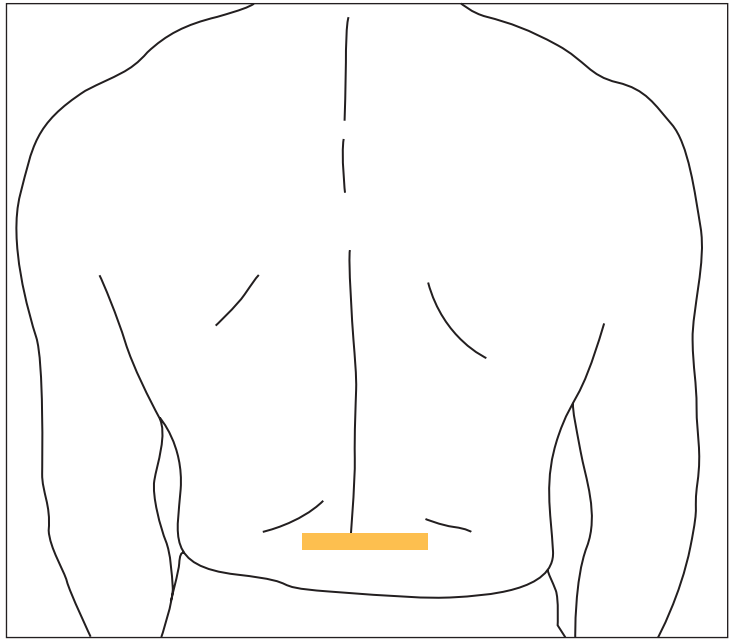

FIG. 160 TS, probe over midline lower lumbar region

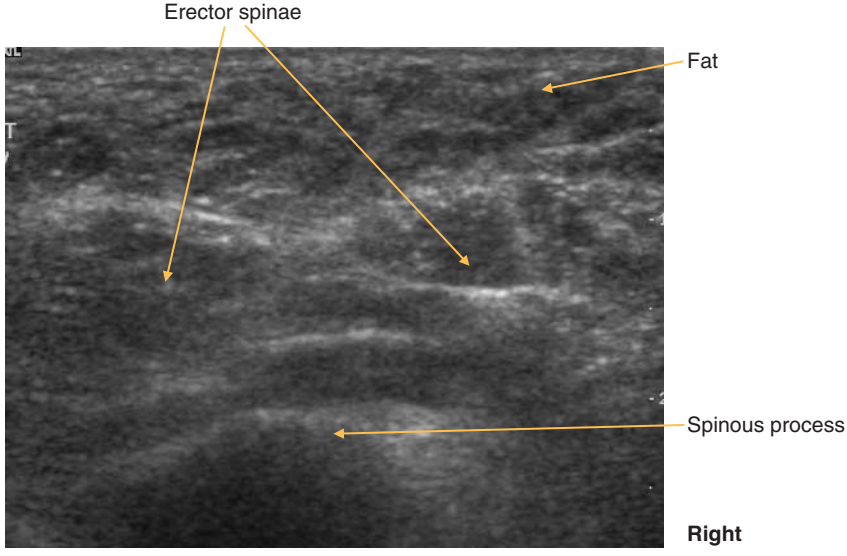

FIG. 161 TS, posterior midline abdominal wall

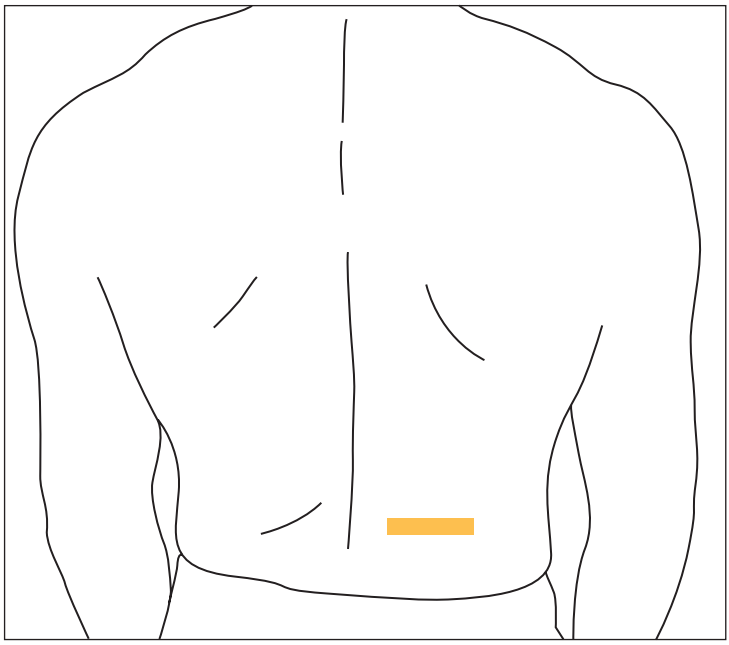

FIG. 162 TS, probe right of midline

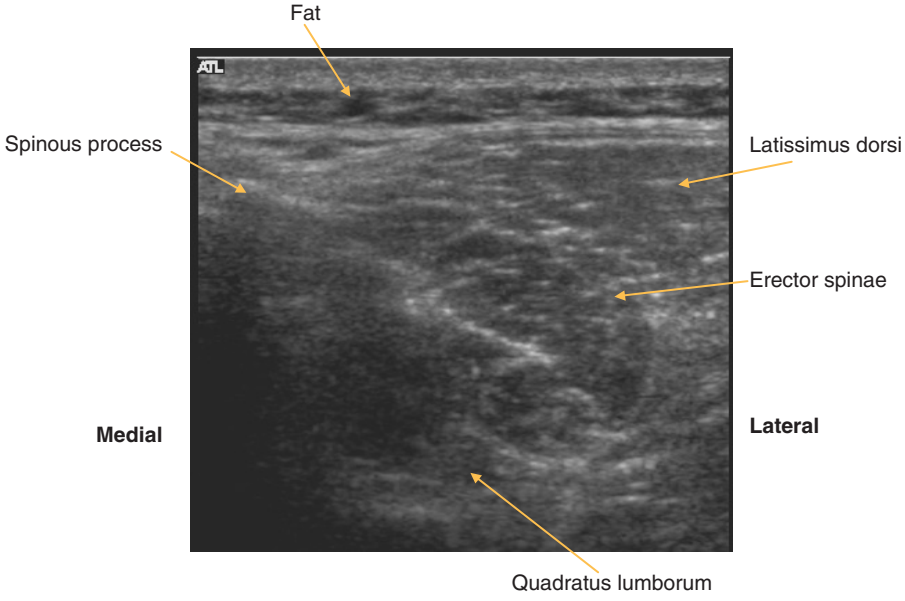

FIG. 163 TS, lumbar region

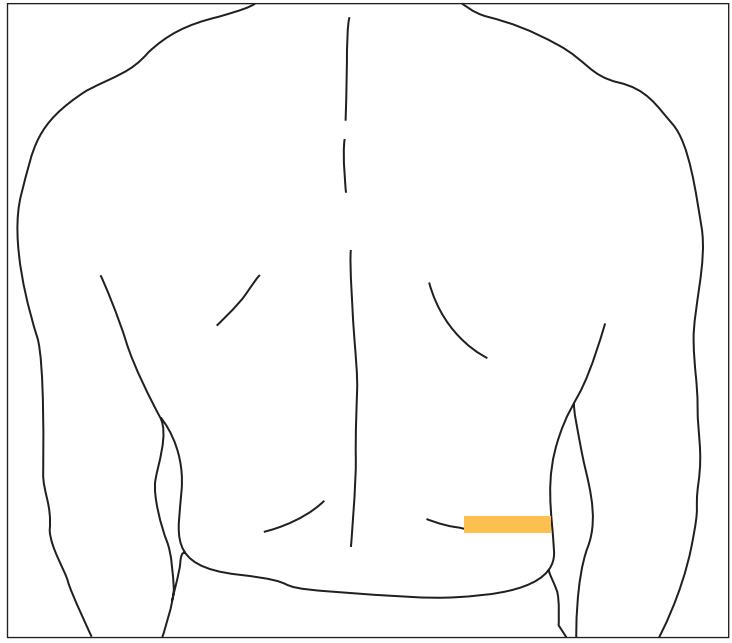

FIG. 164 TS, probe over posterior flank

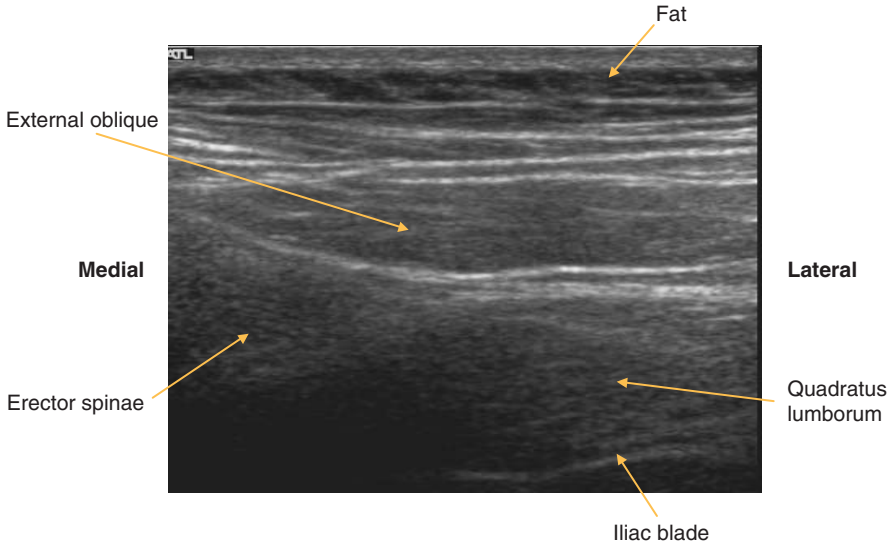

FIG. 165 TS, lumbar area

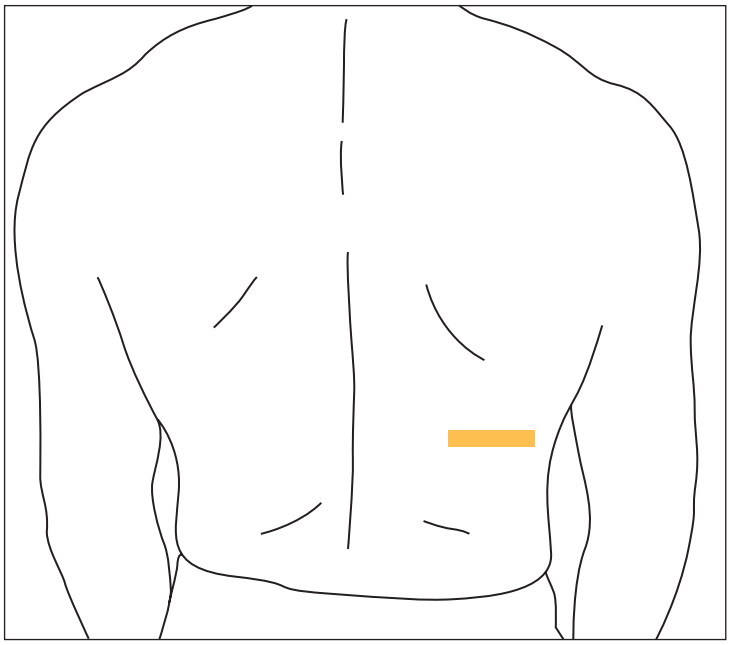

FIG. 166 TS, probe over lumbar triangle

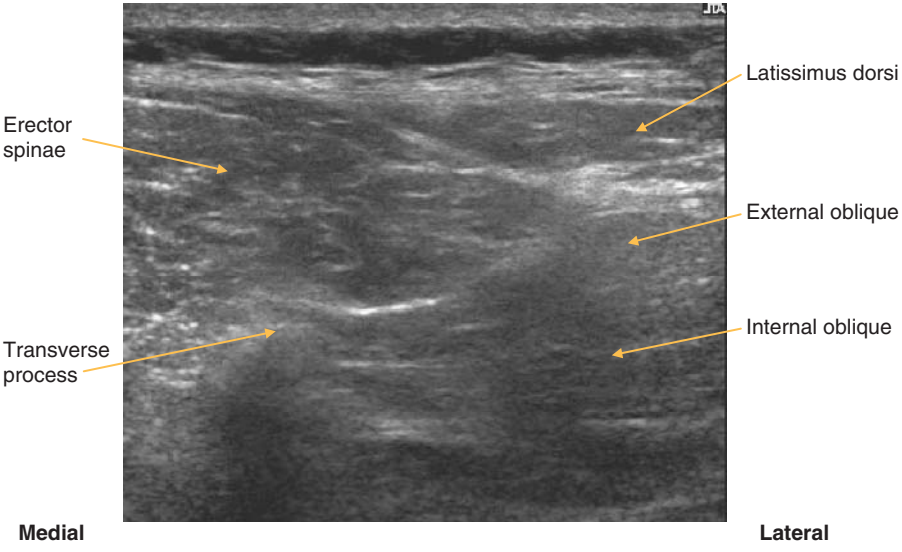

FIG. 167 TS, lumbar triangle

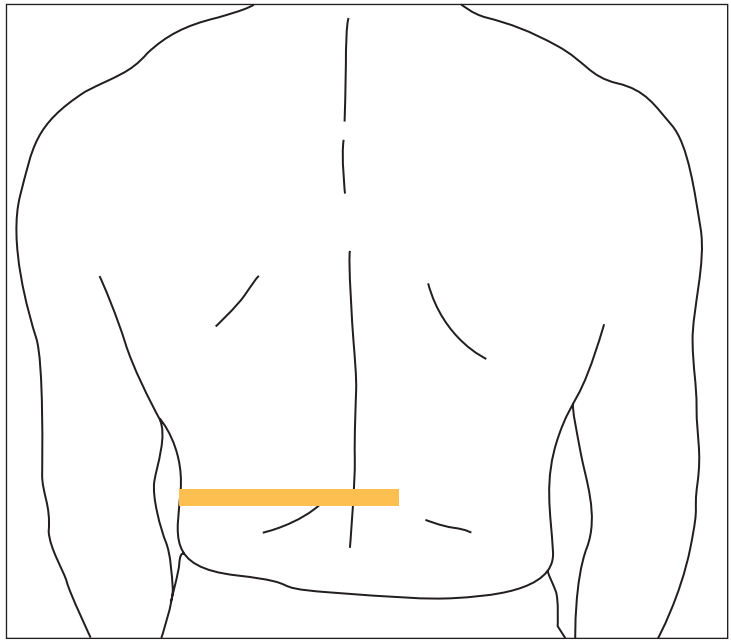

FIG. 168 TS panorama, lumbar region

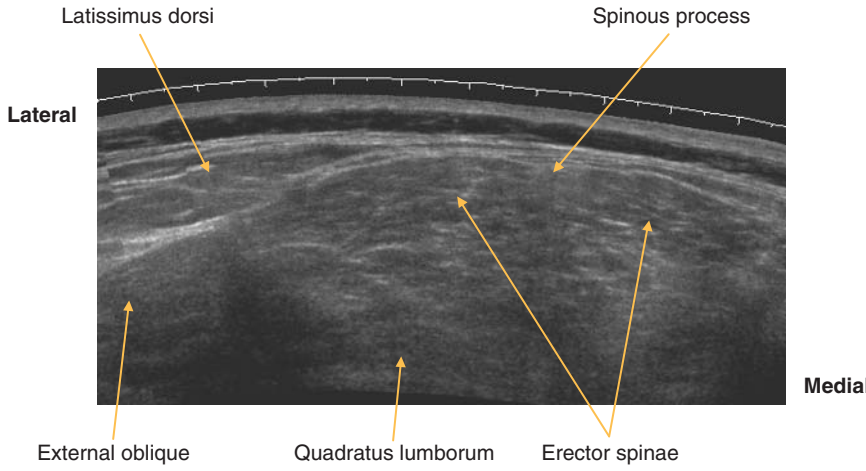

FIG. 169 TS panorama, lumbar region

Groin

(Figures 170 and 171)

- Inguinal ligament
  - The lower free border of the external oblique aponeurosis between pubic tubercle and anterior superior iliac spine.
- Inguinal canal
  - Anterior wall: external oblique aponeurosis, reinforced by internal oblique.
  - Posterior wall: transversalis fascia, reinforced by conjoint tendon medially.

Contents: spermatic cord or round ligament, genito-femoral, ilio-inguinal and sympathetic nerves, testicular, cremasteric, and ductus deferens arteries.

Notes

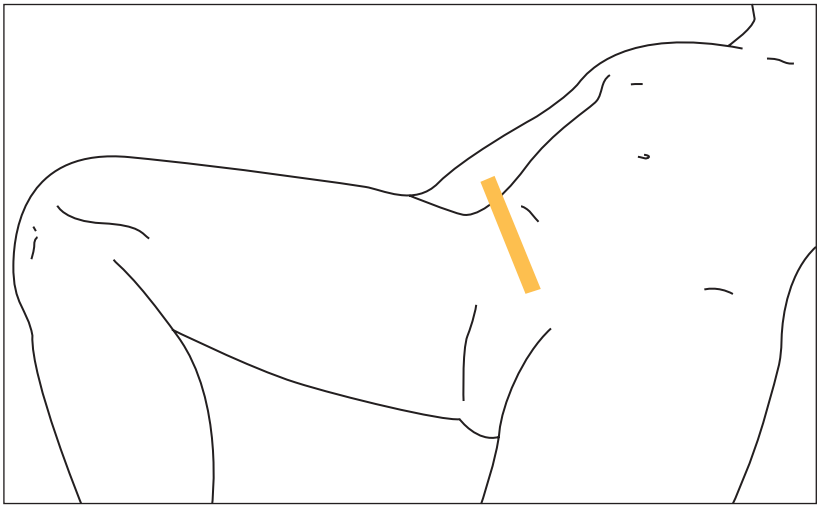

FIG. 170 TS panorama, along inguinal ligament

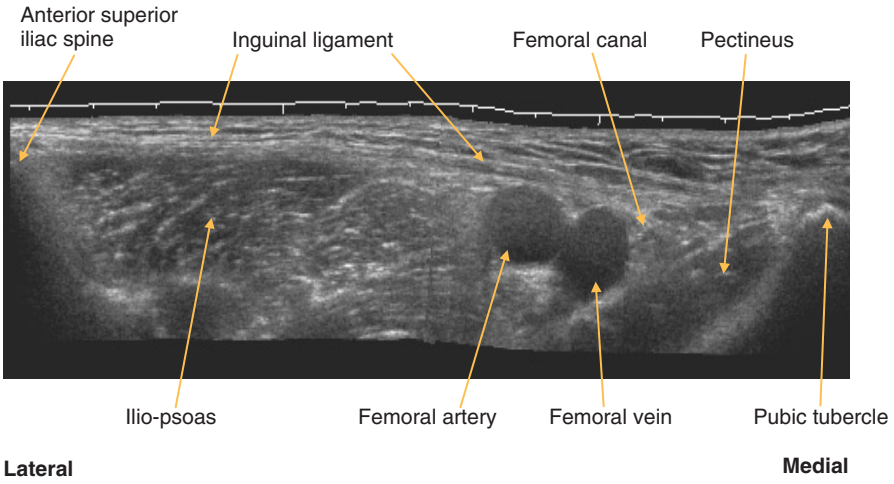

FIG. 171 TS panorama, inguinal ligament

Femoral triangle: boundaries

(Figures 172 and 173)

- Superior: inguinal ligament.
- Lateral: sartorius.
- Medial: adductor longus.
- Floor: adductor longus and pectineus.

Contents: femoral sheath, femoral nerve.

Femoral sheath is a downward extension of the extraperitoneal fascia into the thigh.

Contents

- Lateral: femoral artery.
- Central: femoral vein.
- Medial: fat, lymphatics (femoral canal). This communicates superiorly via the femoral ring with abdominal extraperitoneal fascia.

Notes

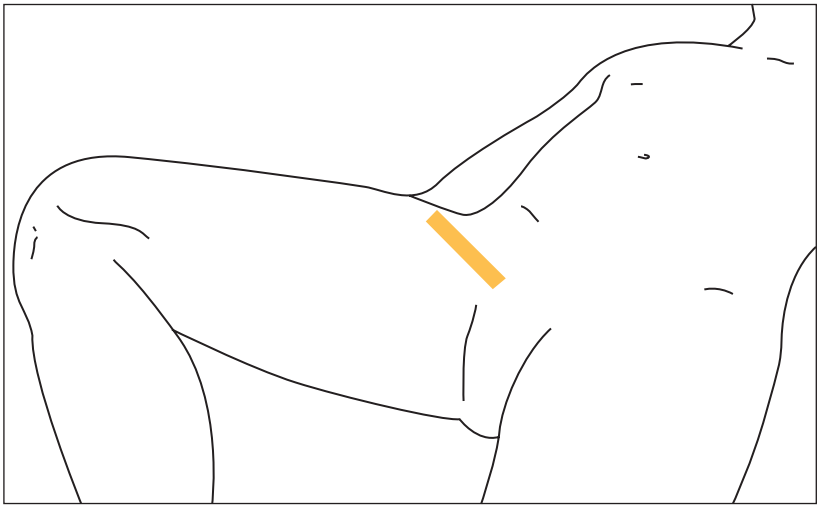

FIG. 172 TS of femoral triangle. Leg abducted or adducted

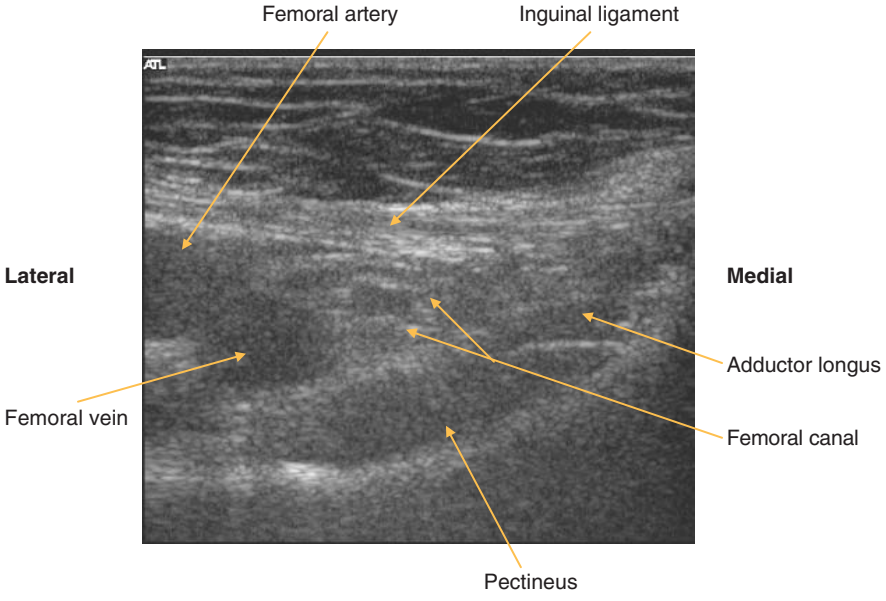

FIG. 173 TS, femoral sheath

Rectus insertion

(Figures 174 and 175)

Notes

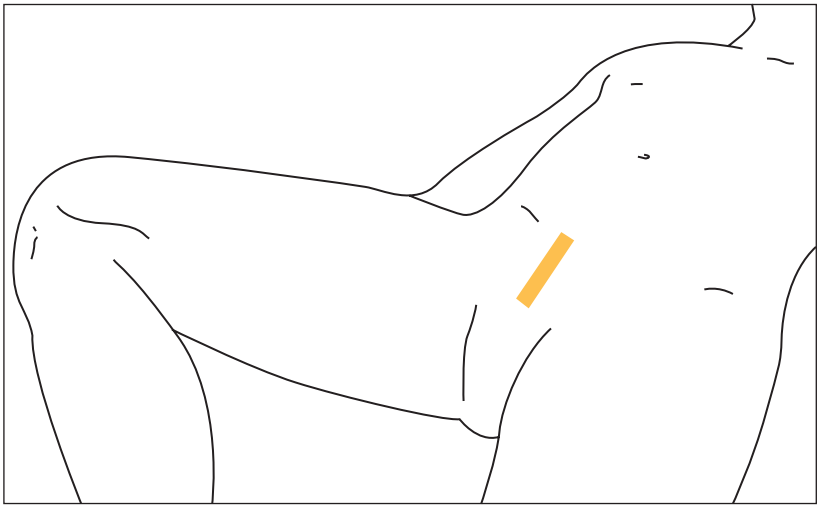

FIG. 174 LS, probe over symphysis

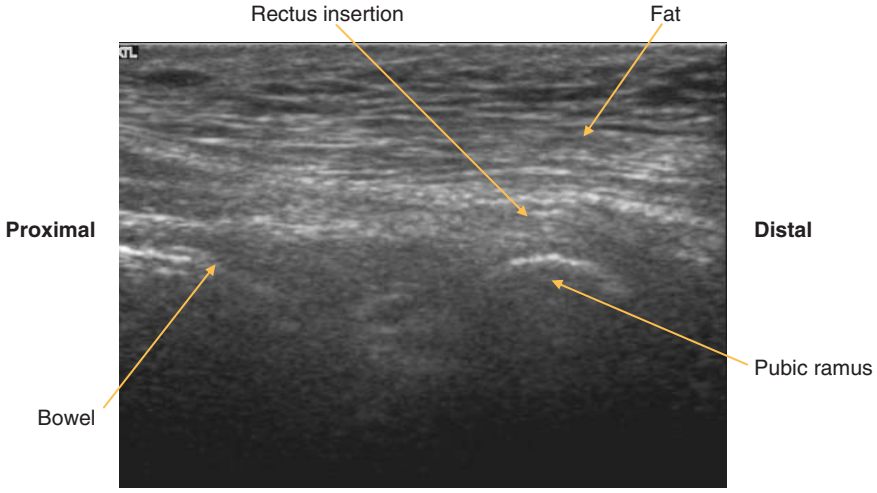

FIG. 175 LS, rectus insertion at symphysis

Symphysis pubis

(Figures 176 and 177)

Symphysis pubis is united by fibrocartilaginous disc and interpubic ligaments.

Notes

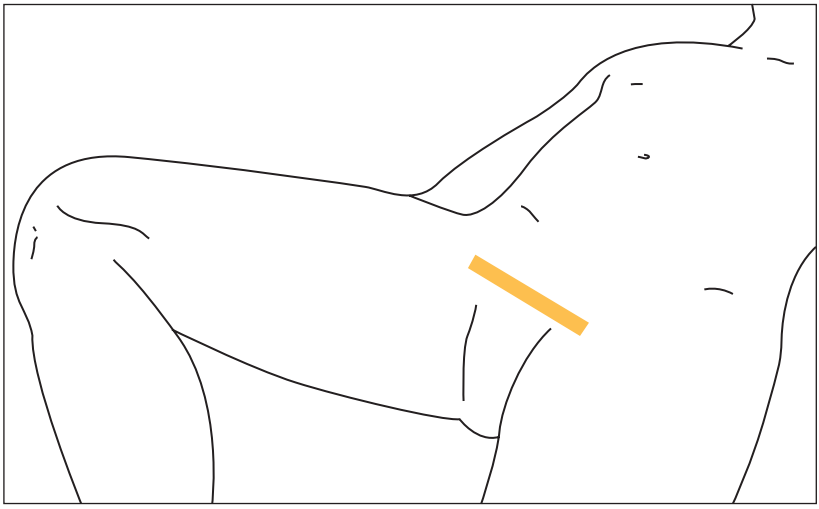

FIG. 176 TS, probe over symphysis

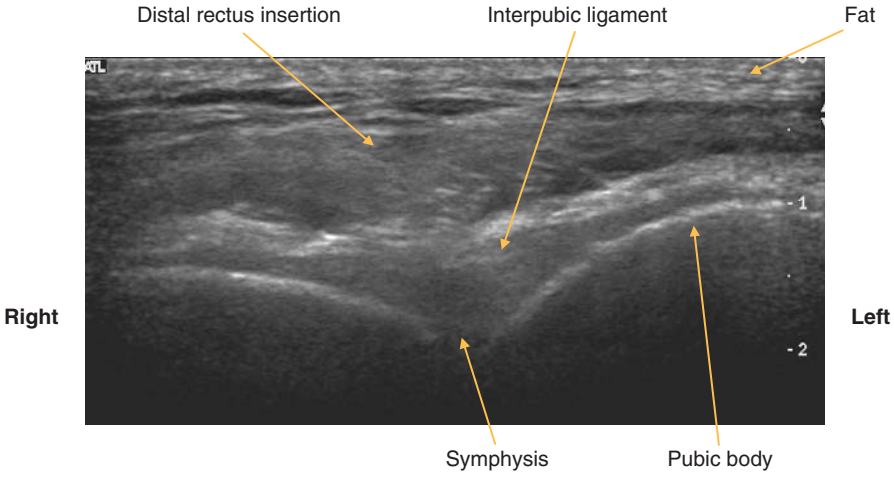

FIG. 177 TS, distal rectus insertion

Conjoint tendon/superficial ring

(Figures 178 and 179)

The superficial ring is a deficiency in the external oblique aponeurosis, at the midpoint of the inguinal ligament, lateral to the conjoint tendon.

Notes

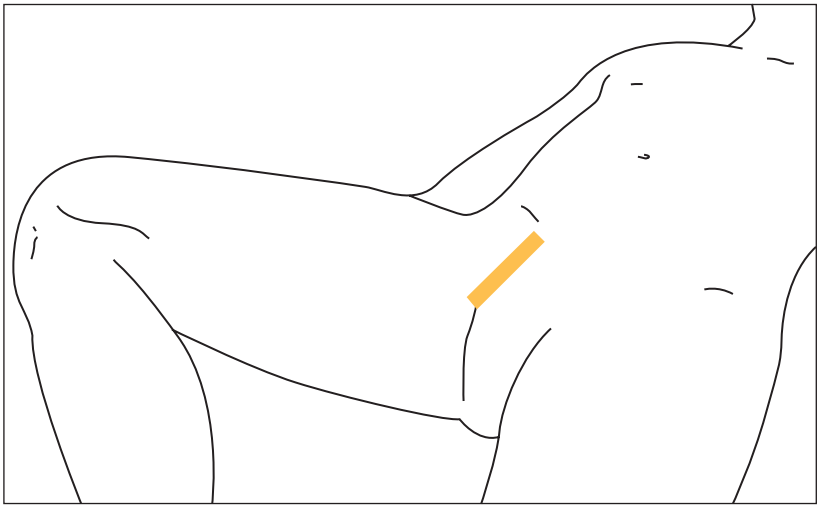

FIG. 178 LS, probe lateral to rectus tendon

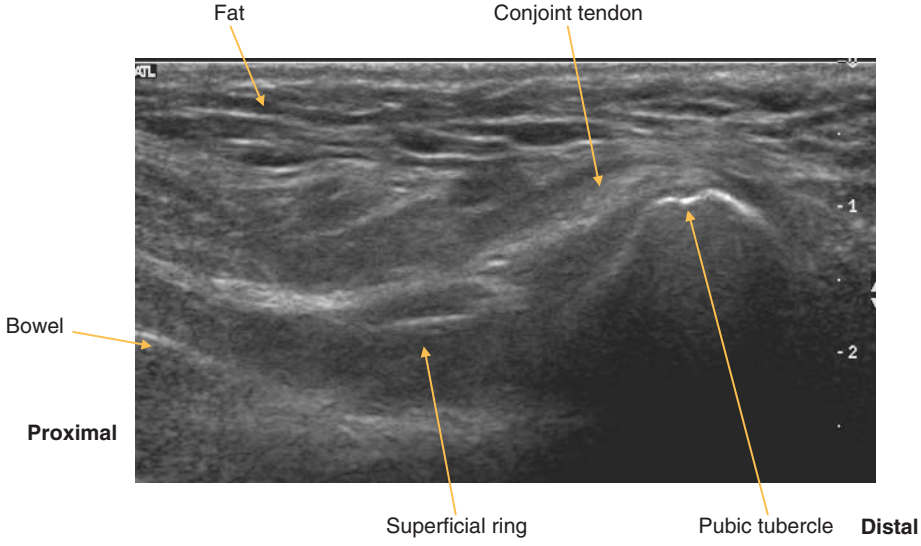

FIG. 179 LS, conjoint tendon

Deep ring: lateral to inferior epigastric vessels

(Figures 180 and 181)

Notes

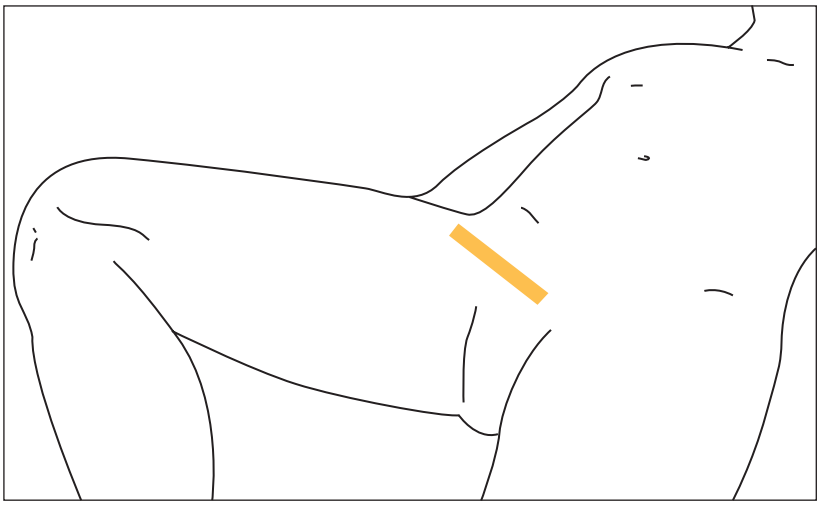

FIG. 180 TS, probe superior to inguinal ligament angled parallel to ligament

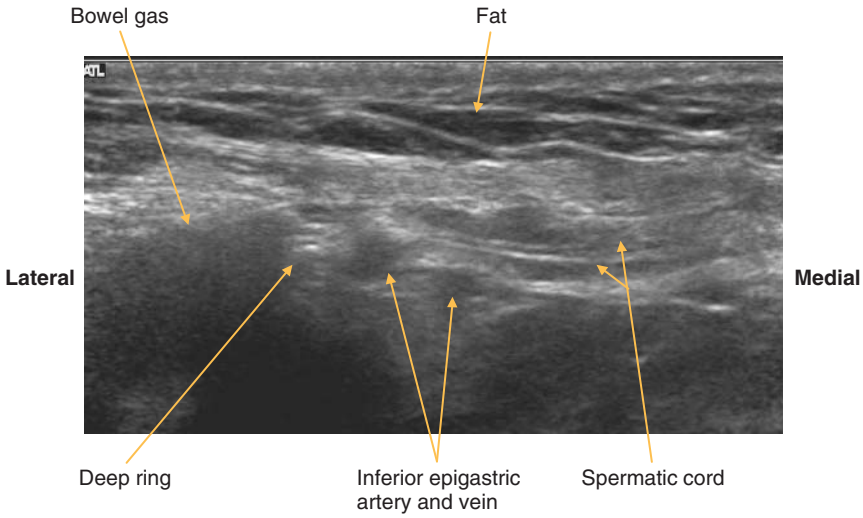

FIG. 181 TS, oblique deep ring

Hip

Synovial ball and socket joint

(Figures 182 and 183)

Anterior

- Ilio-psoas and pectineus separate joint from femoral vessels and nerve.

Notes

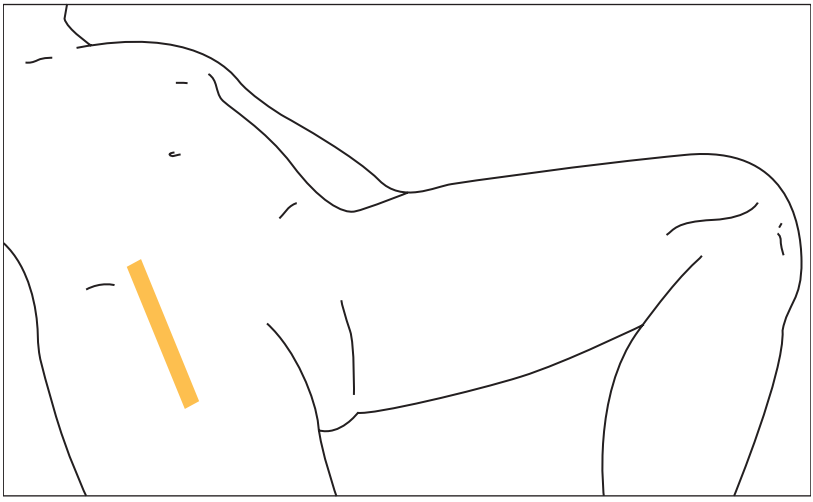

FIG. 182 LS, supine, leg straight

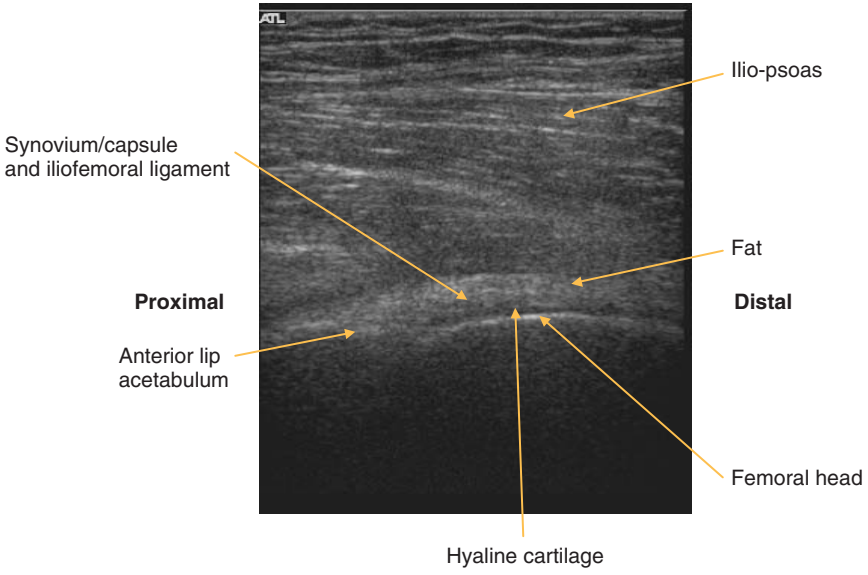

FIG. 183 LS, anterior hip

Femoral neck

(Figures 184–187)

Notes

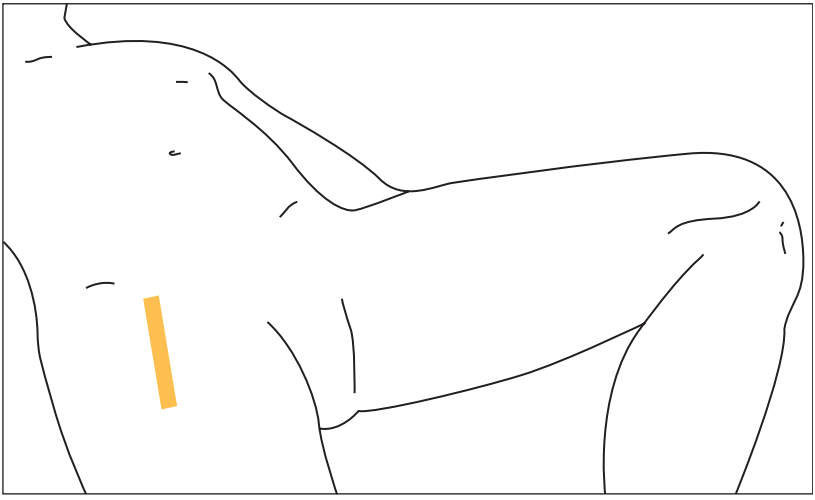

FIG. 184 LS, supine, leg straight, probe slightly distal to femoral head, angled to femoral neck

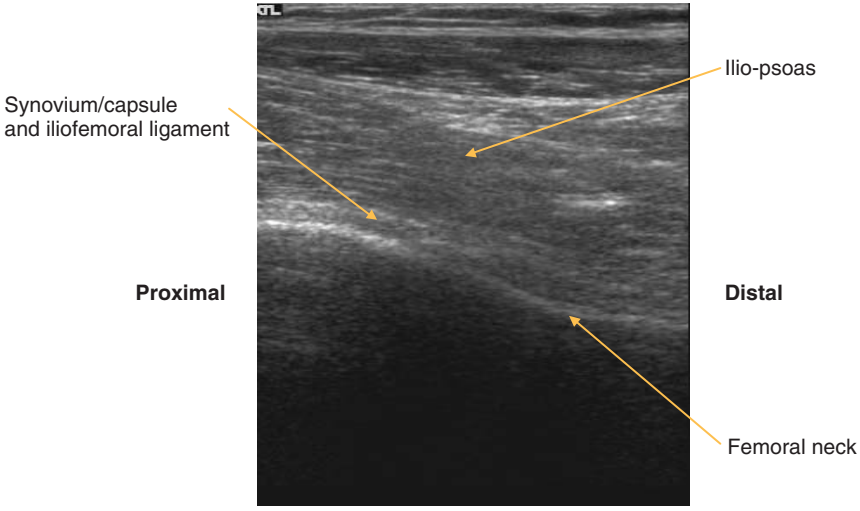

FIG. 185 LS, anterior femoral neck

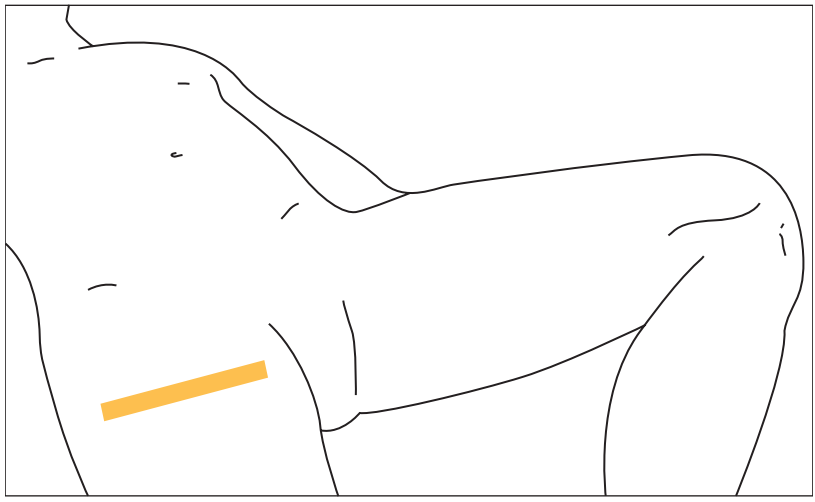

FIG. 186 TS, supine, leg straight, probe slightly distal to femoral head

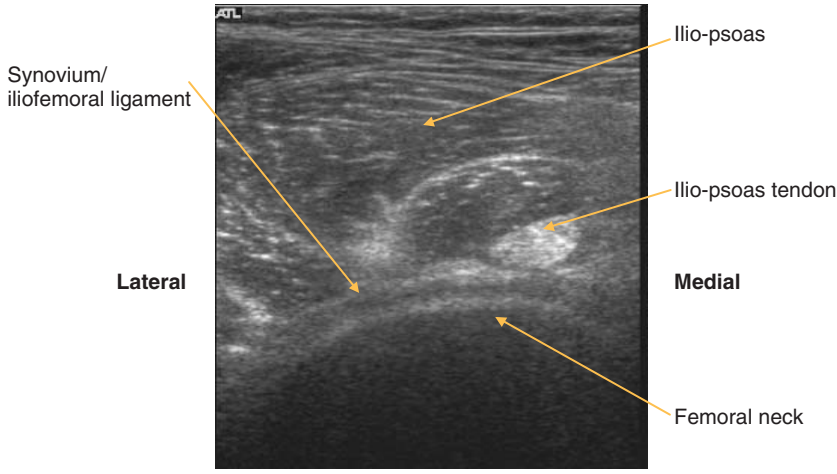

FIG. 187 TS, anterior femoral neck

Ilio-psoas

(Figures 188 and 189)

- Distal insertion: lesser trochanter.
- Sartorius: proximal attachment is at the anterior superior iliac spine, distal insertion is antero-medial tibia.

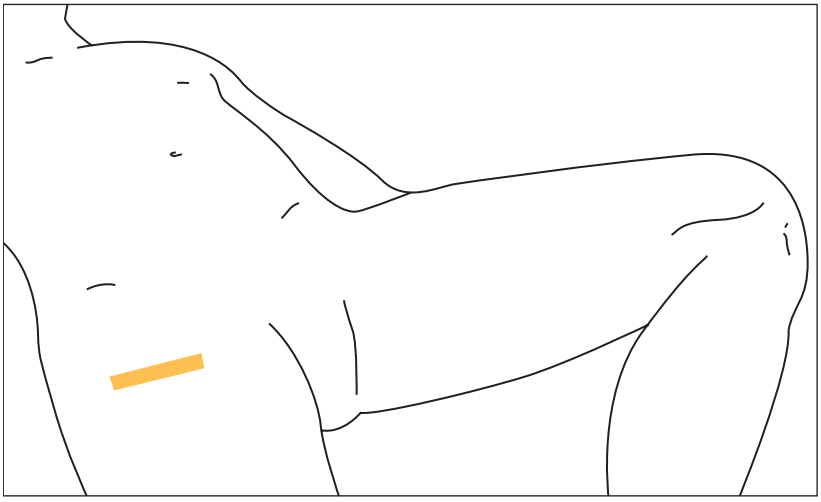

FIG. 188 TS, supine, leg straight

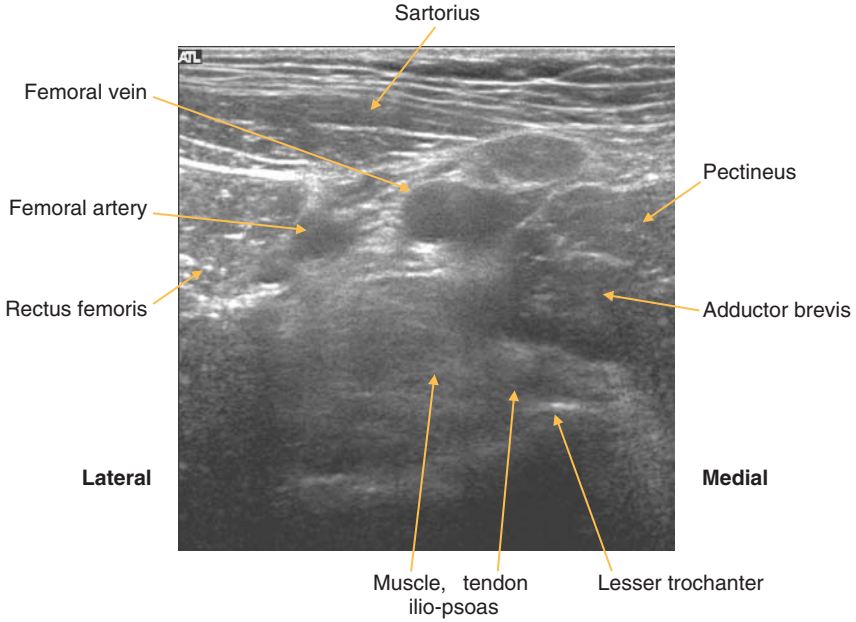

FIG. 189 TS, distal psoas insertion

Panorama of anterior hip

(Figures 190–193)

Notes

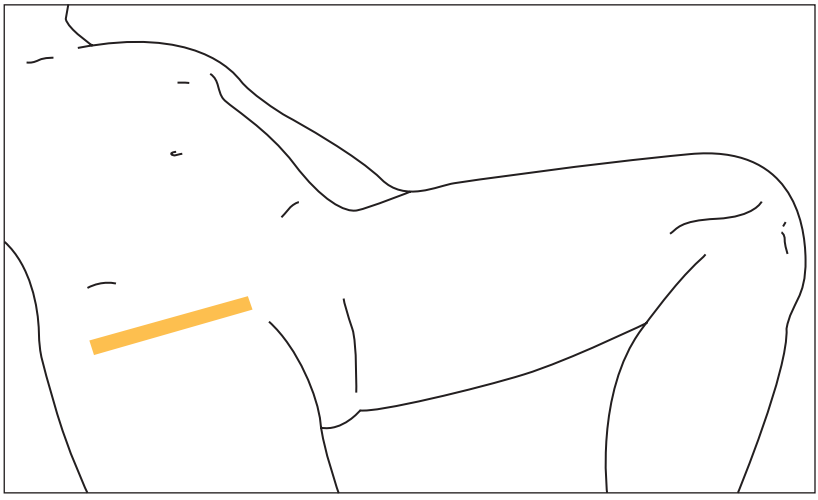

FIG. 190 TS, supine

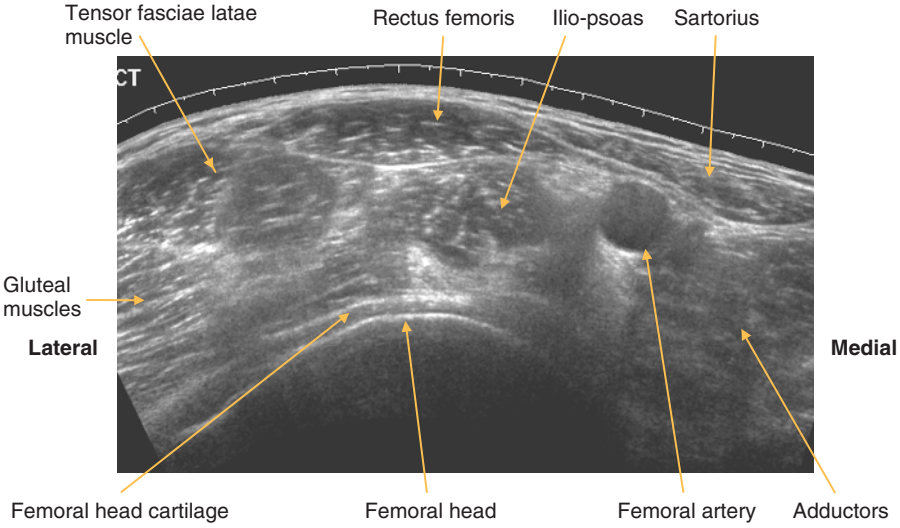

FIG. 191 TS panorama, anterior hip

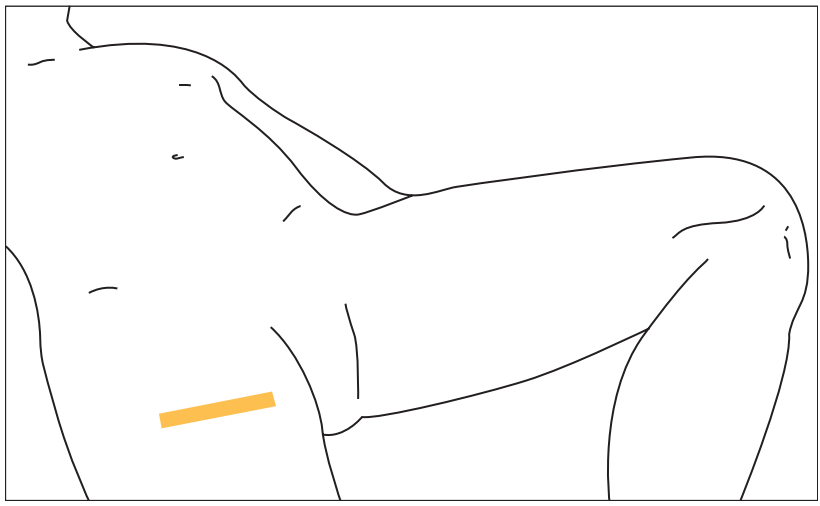

FIG. 192 TS, probe over lesser trochanter

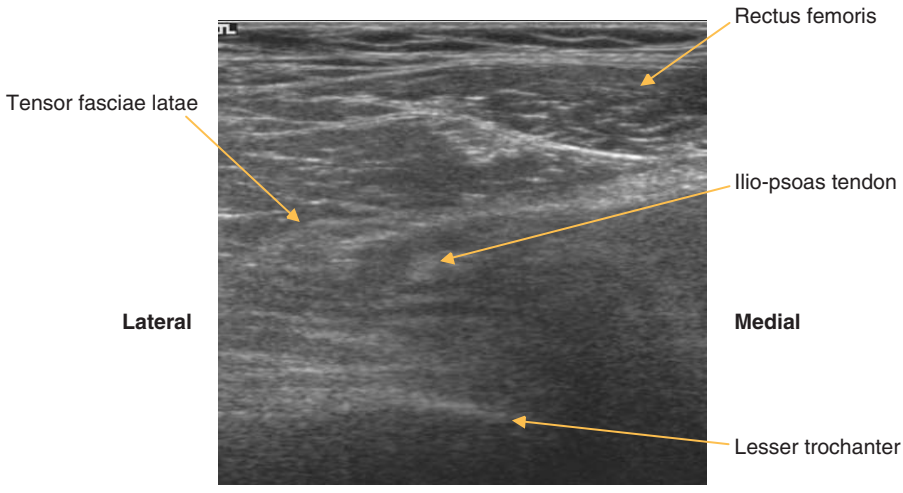

FIG. 193 TS, hip – lesser trochanter

Greater trochanter

(Figures 194 and 195)

- Tensor fasciae latae
  - Origin: iliac crest.
  - Insertion: ilio-tibial tract.
- Gluteus maximus
  - Origin: ilium, sacrum, coccyx.
  - Insertion: ilio-tibial tract, gluteal tuberosity of femur.
- Trochanteric bursa
  - Deep to fascia lata and gluteus.

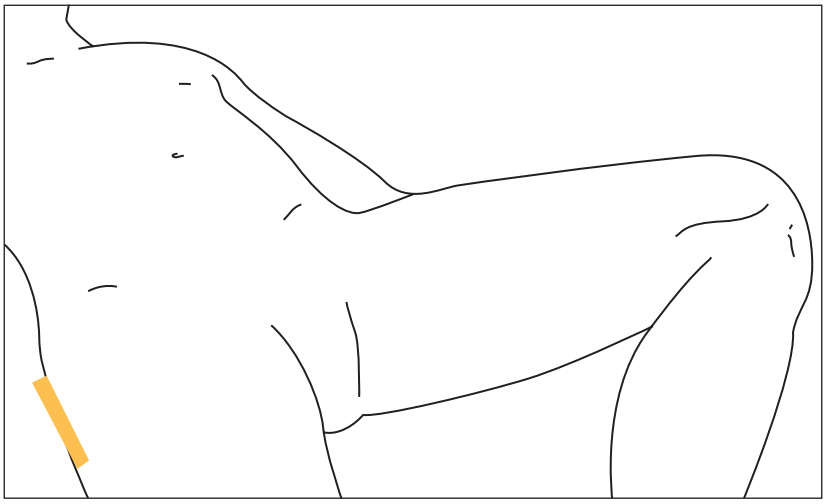

FIG. 194 LS, supine, probe lateral overlying greater trochanter

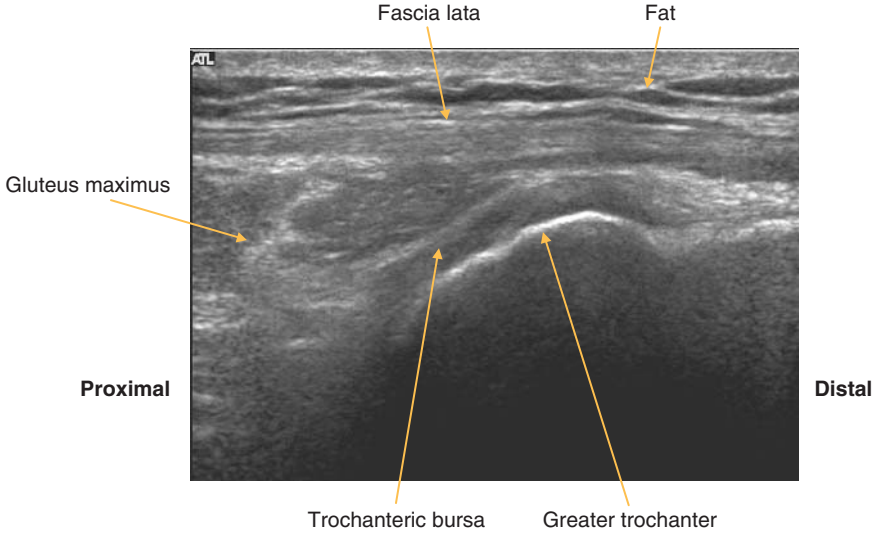

FIG. 195 LS, greater trochanter

Adductors

(Figures 196 and 197)

- Adductor longus
  - Origin: anterior body of pubis.
- Adductor brevis
  - Origin: body and inferior ramus of pubis.
- Adductor magnus
  - Origin: ischiopubic ramus.

Notes

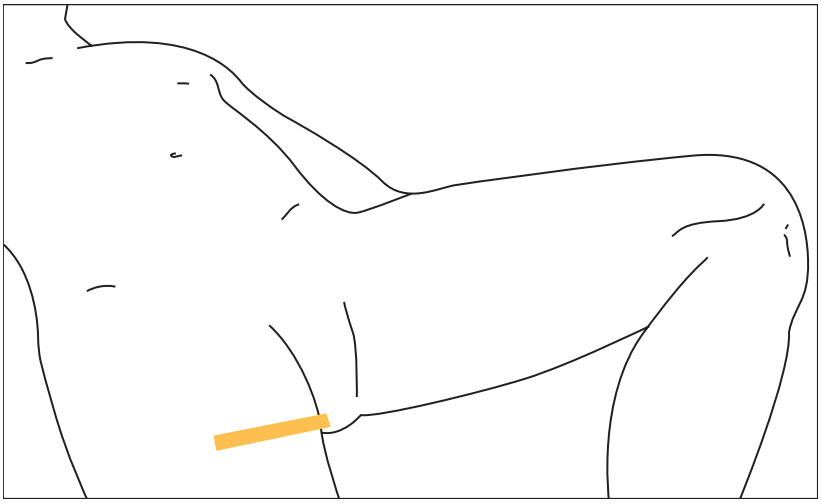

FIG. 196 TS, probe antero-medial thigh. The leg may be semi-flexed and abducted as an alternative position

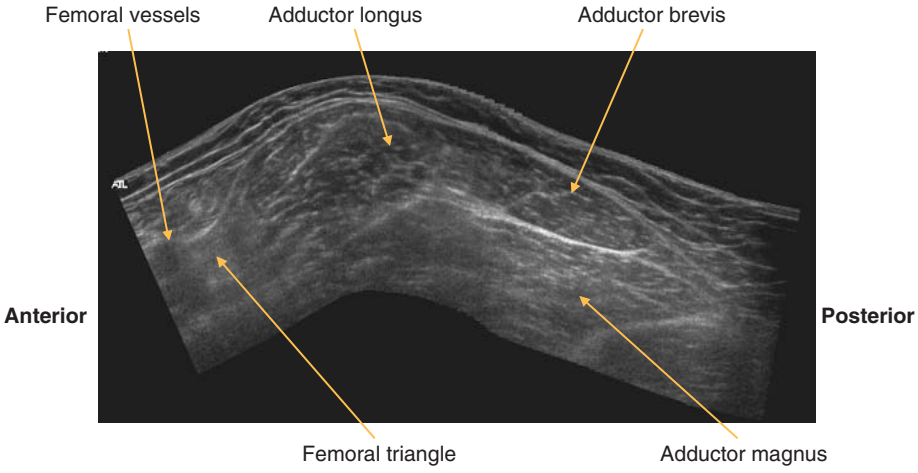

FIG. 197 TS panorama, hip adductors

Adductor origin – LS

(Figures 198 and 199)

Notes

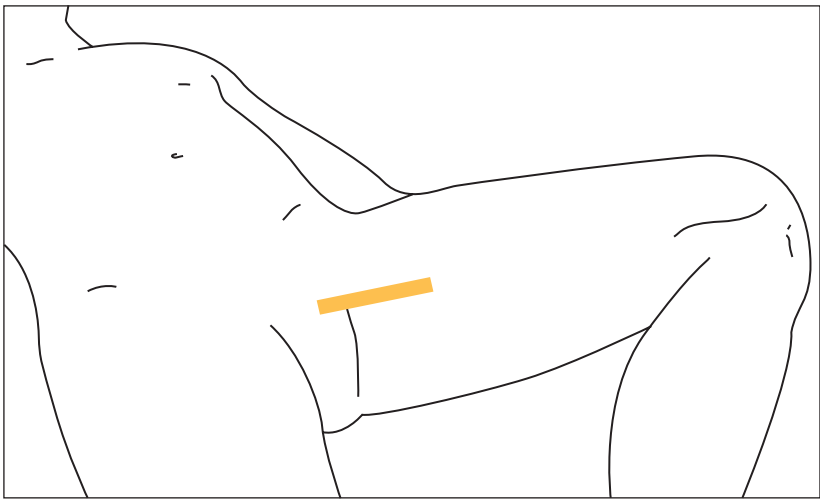

FIG. 198 LS, leg abducted

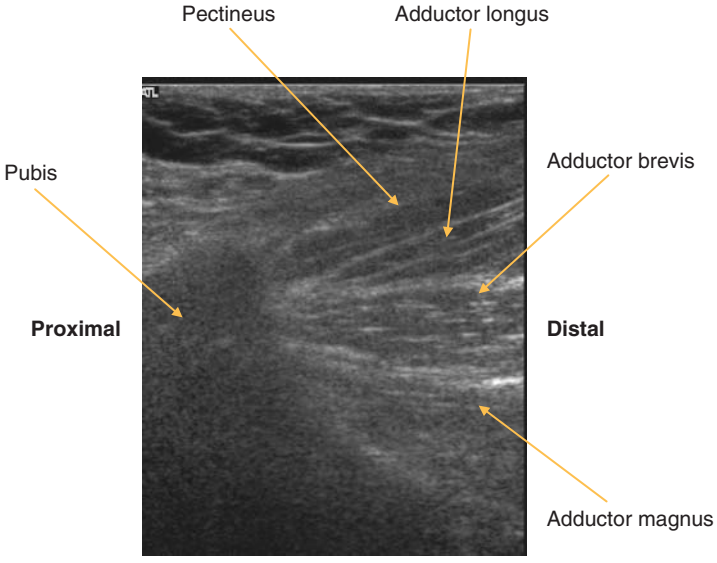

FIG. 199 LS, hip adductors origin

Adductor origin/antero-medial thigh

(Figures 200 and 201)

- Pectineus
  - Origin: pectineal line, pubis to lesser trochanter/linea aspera.
- Adductor longus
  - Anterior pubis to linea aspera.
- Adductor brevis
  - Body and inferior ramus of pubis to linea aspera.
- Adductor magnus
  - Ramus and ischial tuberosity to linea aspera and adductor tubercle on medial femoral condyle.
- Gracilis
  - Pubic ramus to antero-medial tibia.

Notes

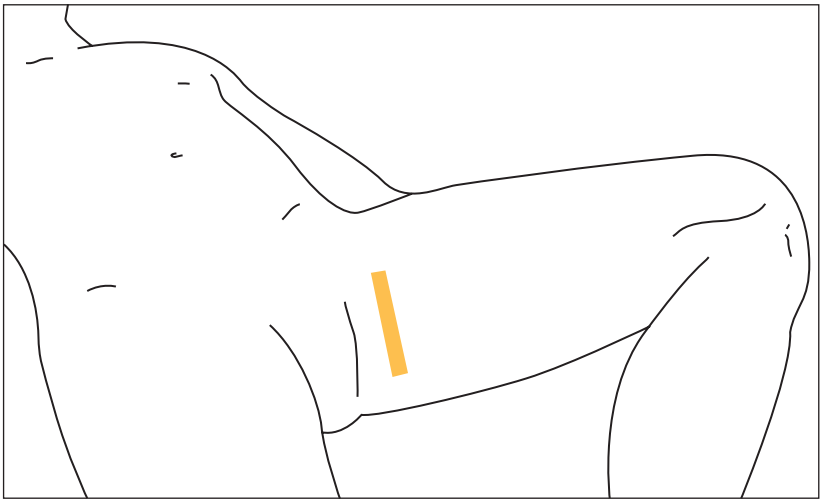

FIG. 200 TS, leg abducted

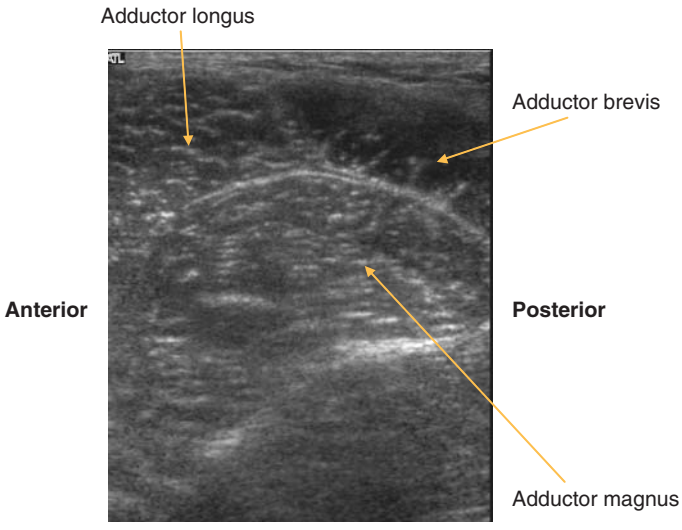

FIG. 201 TS, hip adductors

Rectus femoris

(Figures 202 and 203)

- Origin: anterior inferior iliac spine and ilium superior to acetabulum.
  - ✦ Insertion: upper border of patella.

Notes

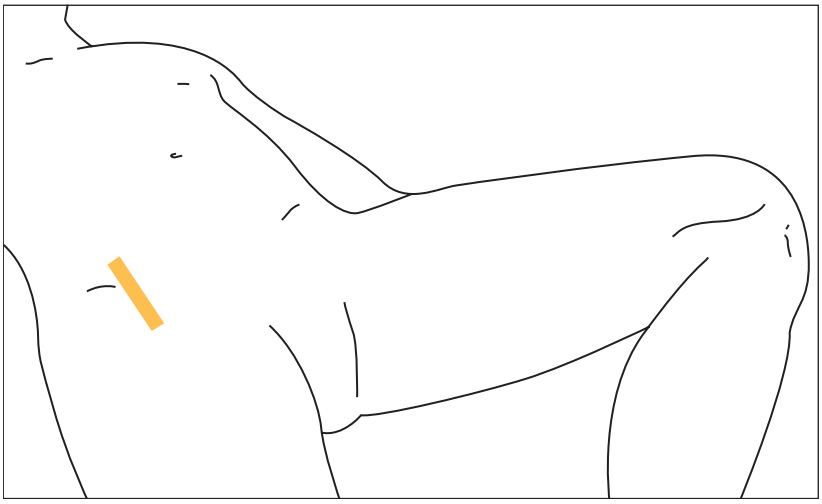

FIG. 202 LS, supine, proximal to hip joint

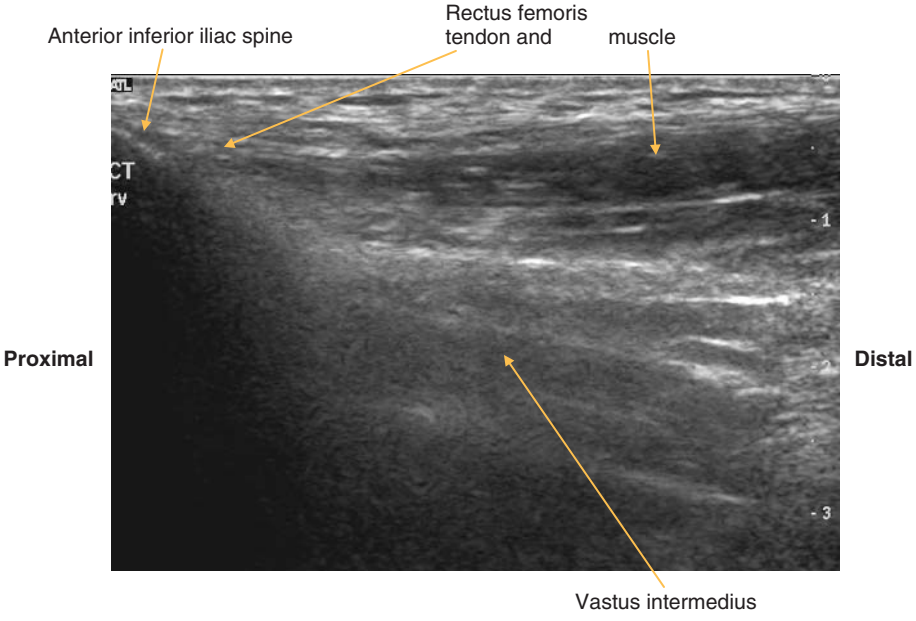

FIG. 203 LS, proximal rectus femoris insertion

Rectus femoris – TS

(Figures 204 and 205)

Notes

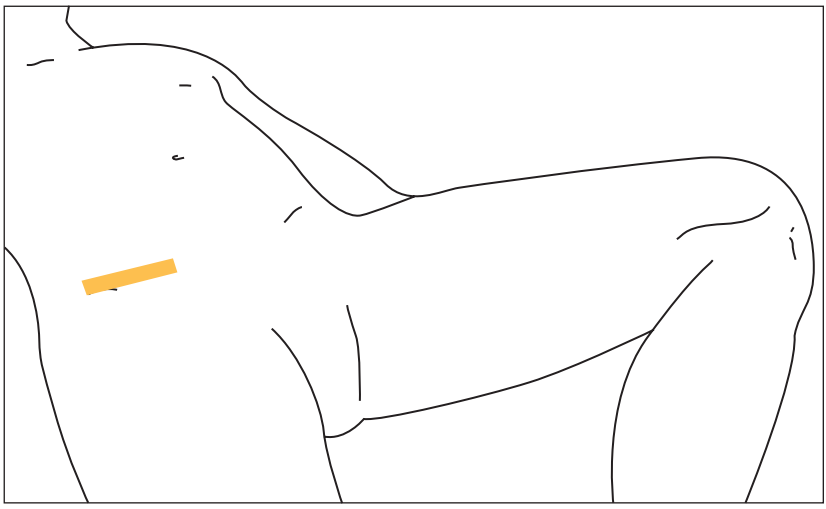

FIG. 204 TS, supine, proximal to hip joint

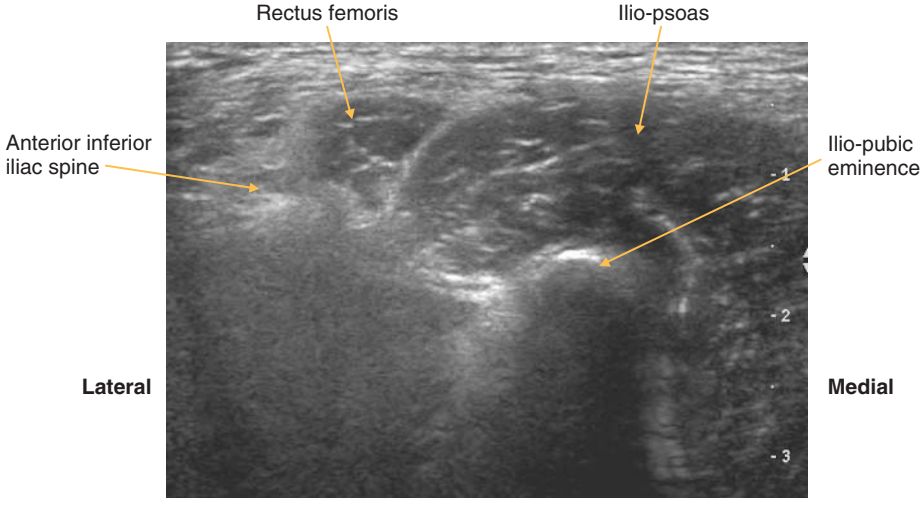

FIG. 205 TS, proximal rectus femoris

Hamstrings

(Figures 206 and 207)

- Origin: (lateral to medial).
- Semimembranosus: ischial tuberosity.
- Biceps femoris and semitendinosus: common tendon from the ischial tuberosity (short head of biceps from linea aspera).

Notes

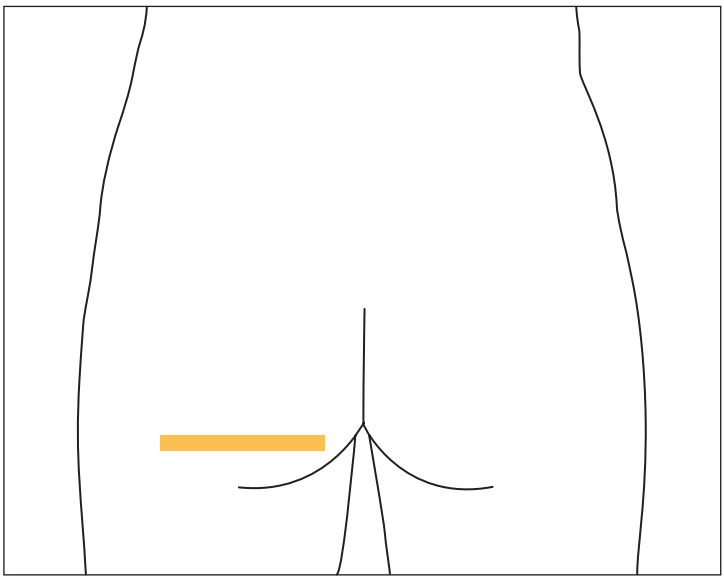

FIG. 206 TS, patient prone, probe over ischial tuberosity

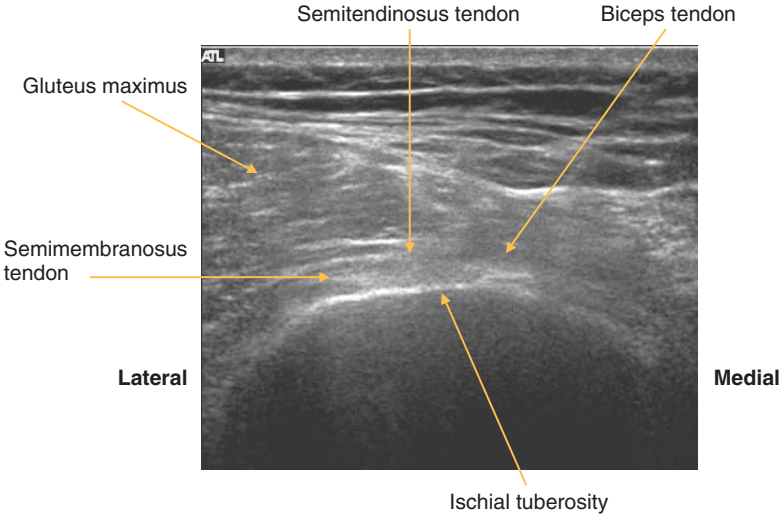

FIG. 207 TS, hamstring insertion

Biceps femoris

(Figures 208 and 209)

Origin – LS.

Notes

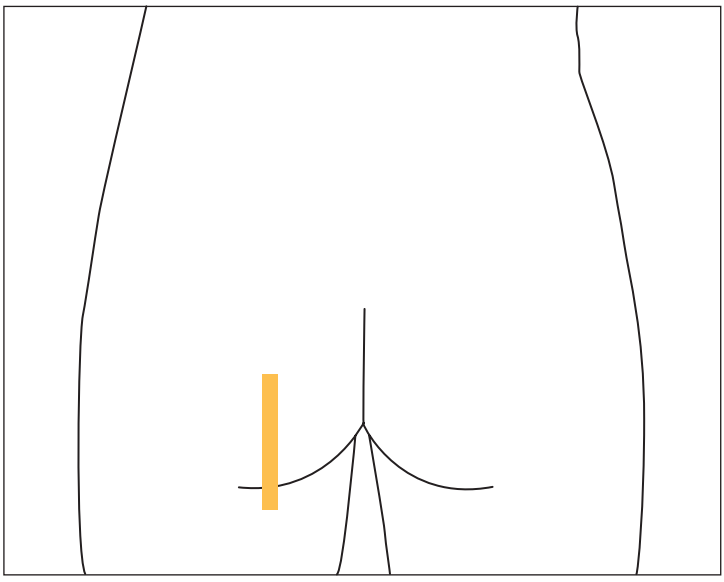

FIG. 208 LS, prone, probe over mid-ischial tuberosity

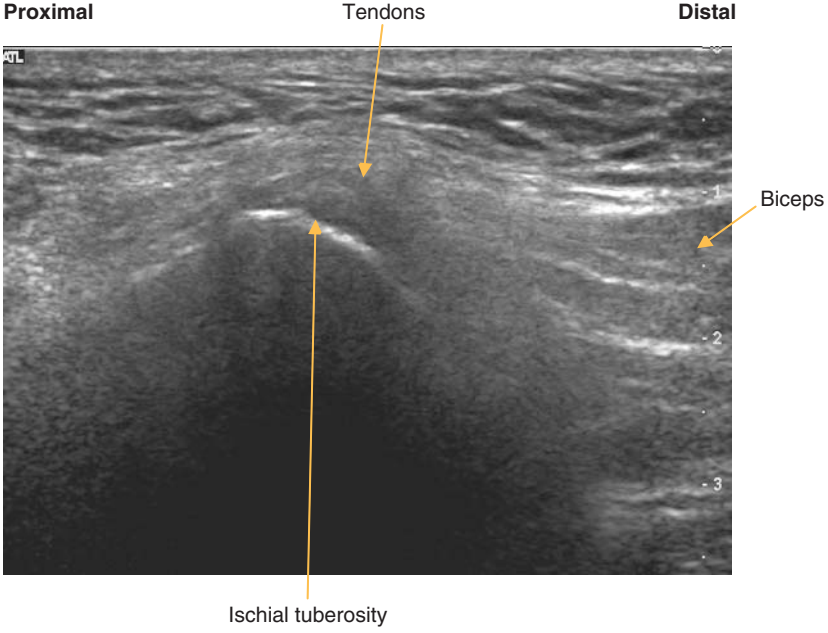

FIG. 209 LS, hamstring insertion

Lower limb

Thigh 172
Knee 184
Calf 214
Ankle 224
Foot 244

Thigh

Anterior

(Figures 210–217)

- Sartorius
  - *Origin*: anterior superior iliac spine *insertion*, antero-medial tibia.
- Quadriceps
  - Rectus femoris: *origin* – anterior inferior iliac spine and ilium.
  - Vastus lateralis: *origin* – greater trochanter and linea aspera.
  - Vastus medialis: *origin* – linea aspera and lesser trochanter.
  - Vastus intermedius: *origin* – anterior and lateral surface of femur.

  The quadriceps muscles insert onto the upper pole of the patella.

Notes

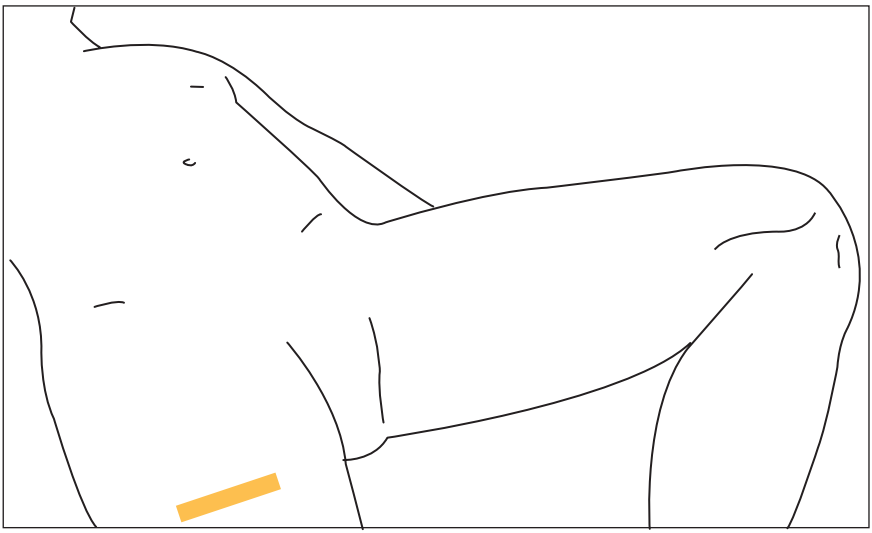

FIG. 210 TS, supine, probe over anterior thigh

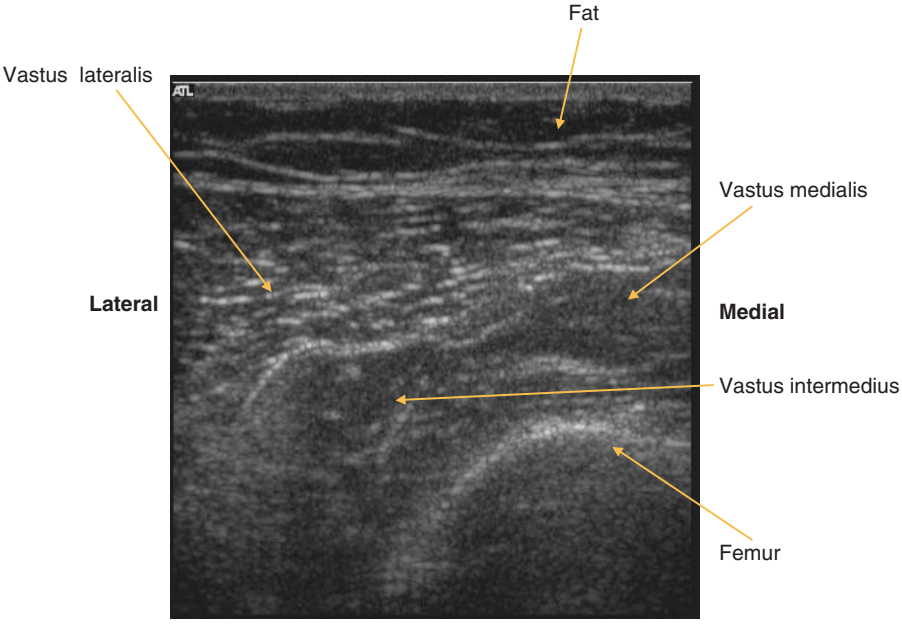

FIG. 211 TS, antero-lateral mid-thigh

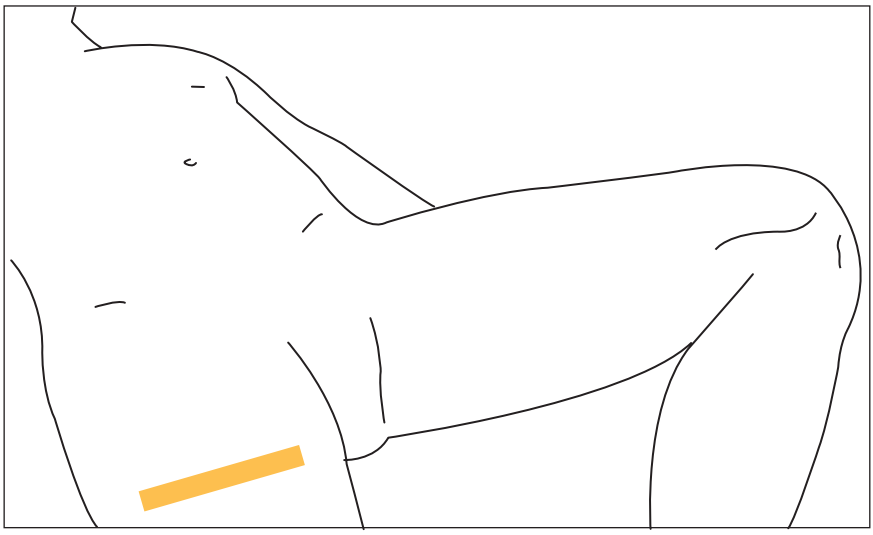

FIG. 212 TS anterior thigh

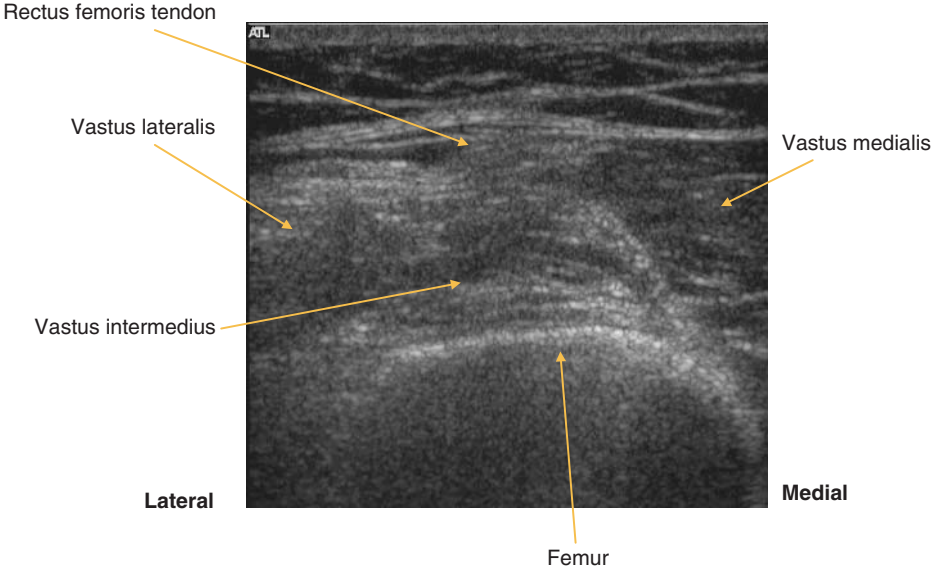

FIG. 213 TS, anterior thigh

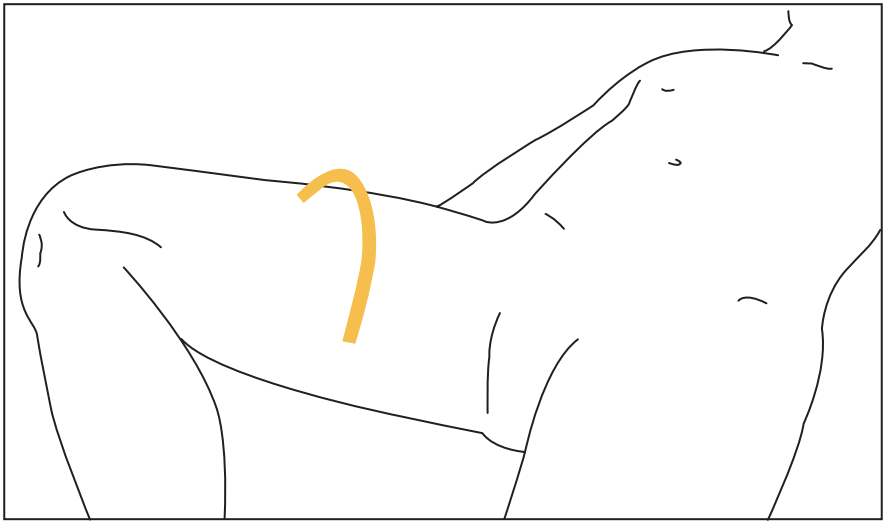

FIG. 214 TS panorama, anterior thigh

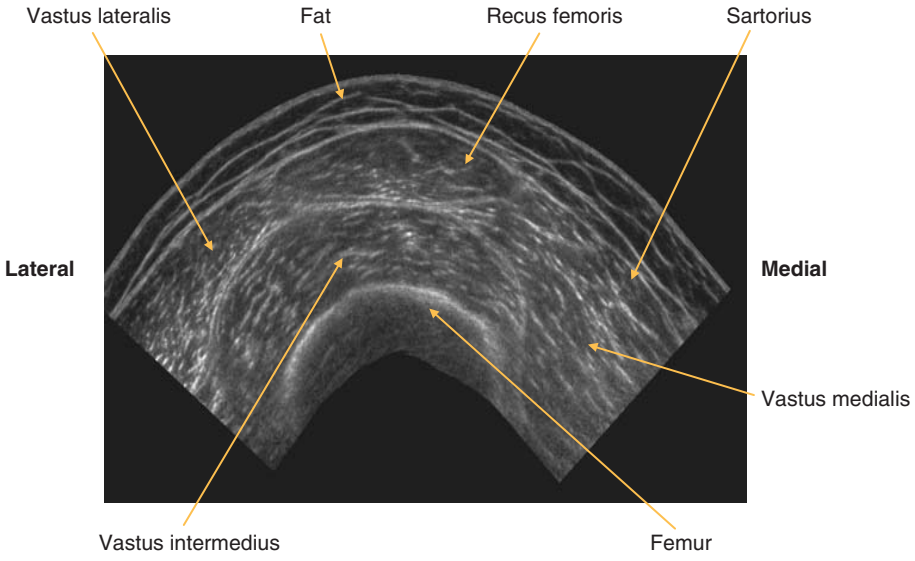

FIG. 215 TS, mid-thigh

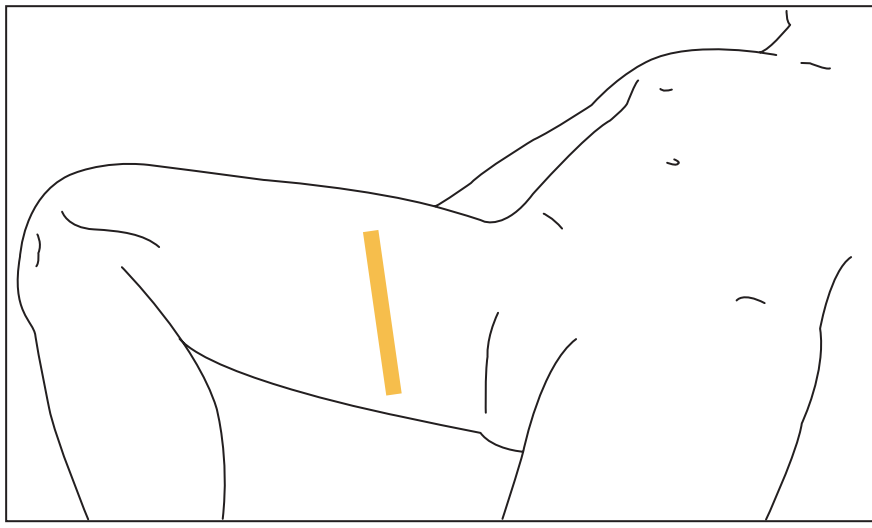

FIG. 216 TS panorama, antero-medial thigh

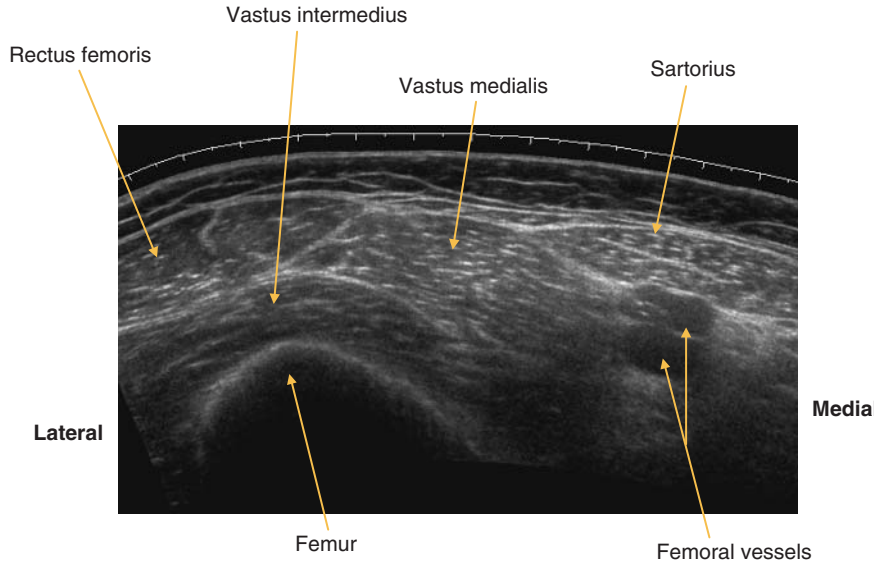

FIG. 217 TS panorama, antero-medial thigh

Ilio-tibial tract

(Figures 218 and 219)

Broad thickening of the fascia lata arising from the outer lip of iliac crest and inserting on the antero-lateral aspect of tibia. Gluteus maximus and tensor fasciae latae are attached to it.

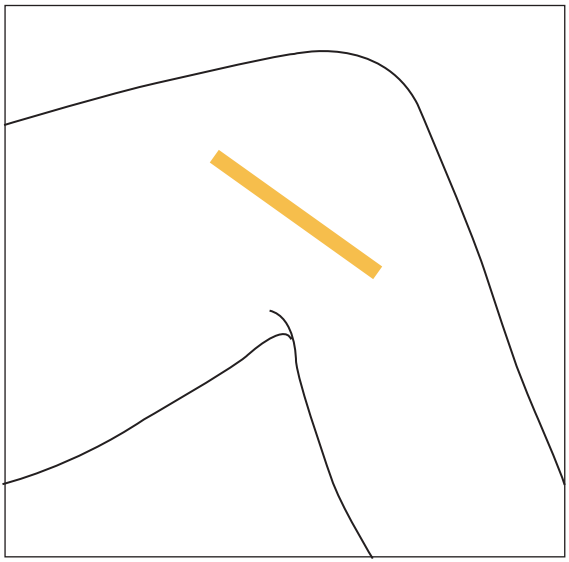

FIG. 218 LS, knee flexed, lateral aspect

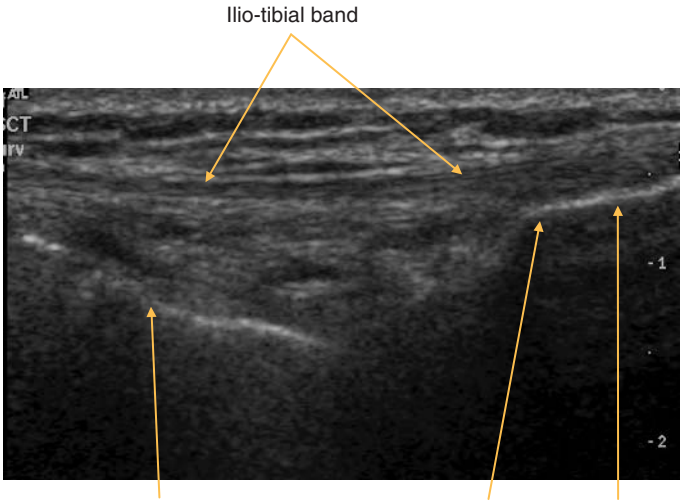

FIG. 219 LS, Ilio-tibial band, distal

Posterior thigh

(Figures 220 and 221)

Hamstrings

- Semimembranosus
  - insertion: postero-medial tibial condyle.
- Semitendinosus
  - insertion: medial tibia (pes anserinus).
- Biceps femoris
  - insertion: fibular apex.

Notes

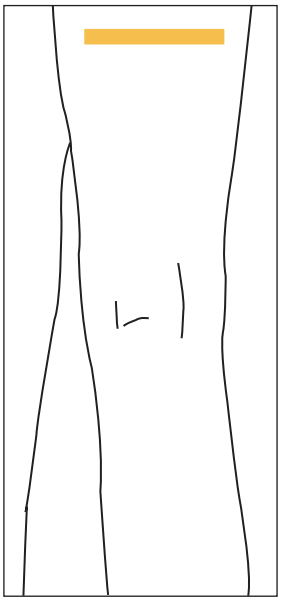

FIG. 220 TS, prone, posterior thigh

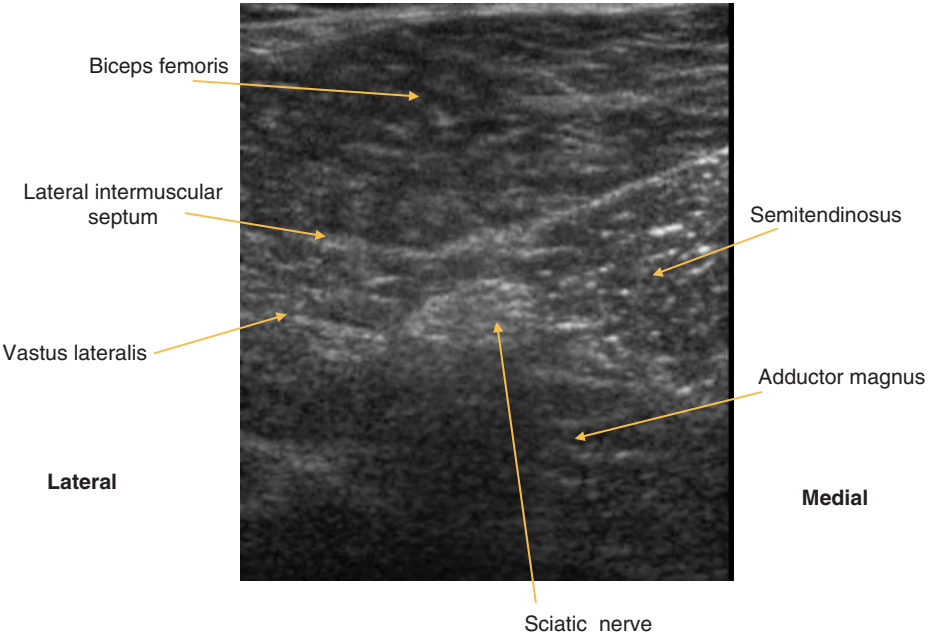

FIG. 221 TS, mid-posterior thigh

Sciatic nerve

(Figures 222 and 223)

This nerve is covered by gluteus maximus and hamstring muscles and lies on ischium, obturator internus, quadratus femoris, and adductor magnus.

Notes

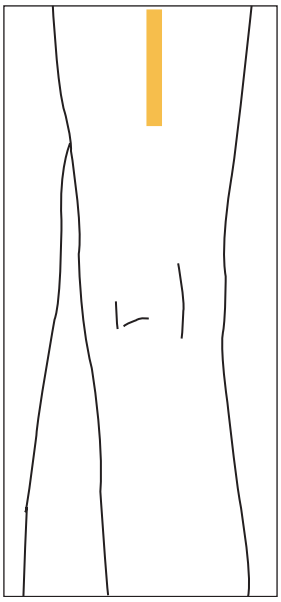

FIG. 222 LS, prone, posterior thigh

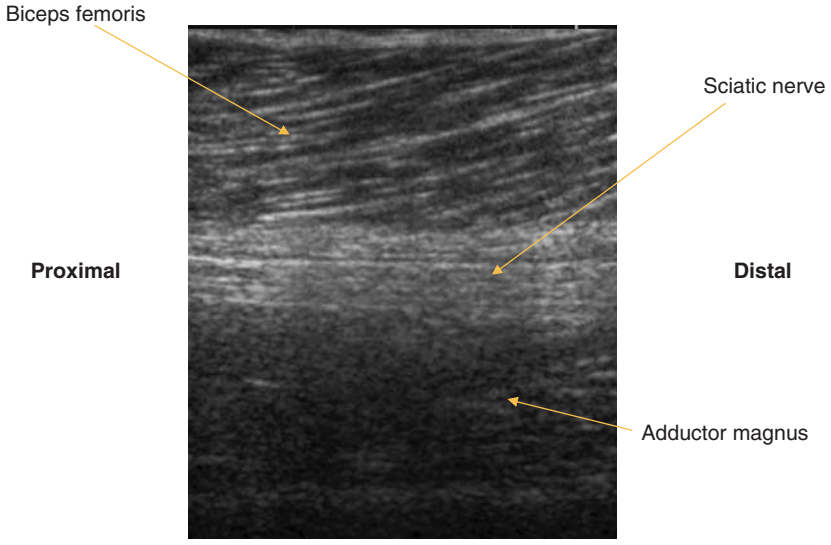

FIG. 223 LS, mid-posterior thigh

Adductor canal

(Figures 224 and 225)

Femoral vessels pass through opening in adductor magnus just above adductor tubercle to the posterior knee.

Notes

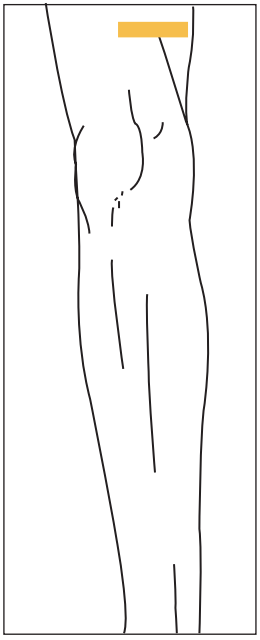

FIG. 224 TS, supine, probe antero-medial

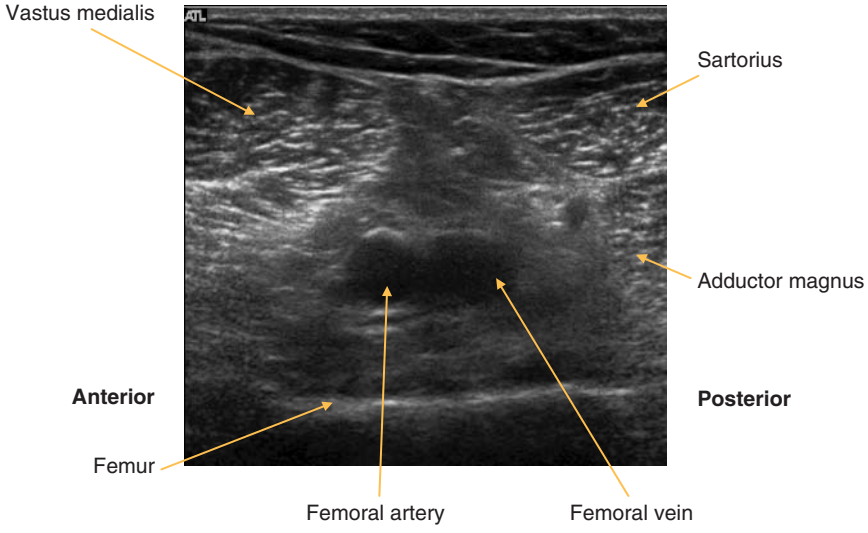

FIG. 225 Distal anterior medial thigh, adductor canal

Knee

Modified hinge synovial joint.

Anterior knee

(Figures 226–233)

Quadriceps tendon – rectus femoris, vastus lateralis, medialis, intermedius.
Patella tendon – single musculotendinous expansion from lower patella to tibial tuberosity.

Bursae

- Superficial pre-patellar
  - superficial to lower patella and proximal patellar tendon.
- Deep infrapatellar
  - deep to patella tendon, separating it from tibia.

Notes

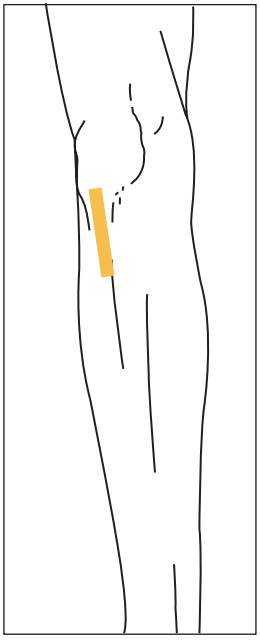

FIG. 226 LS, probe distal to patella. Contract quads or flex knee to straighten tendon, avoiding anisotropy

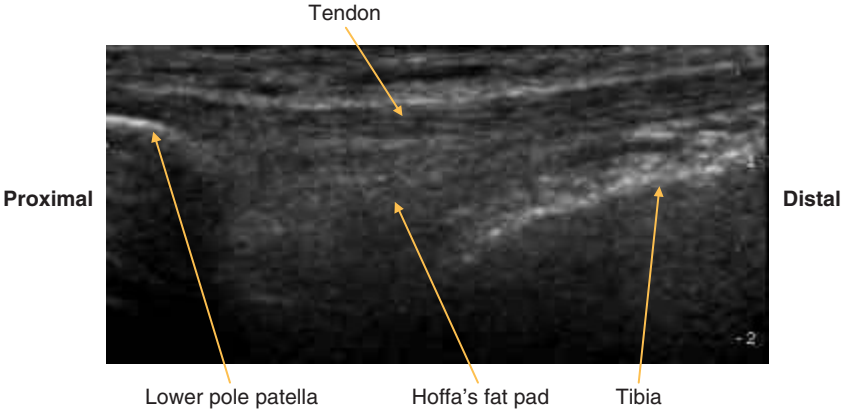

FIG. 227 LS, patellar tendon proximal insertion

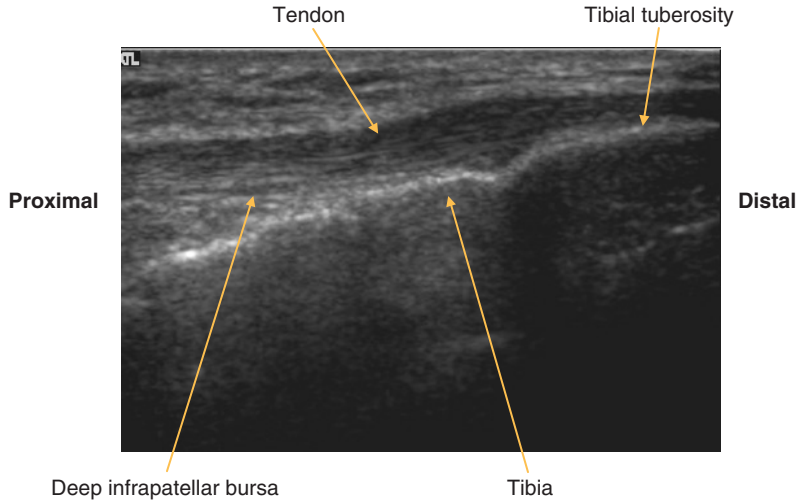

FIG. 228 LS, patellar tendon, tibial insertion

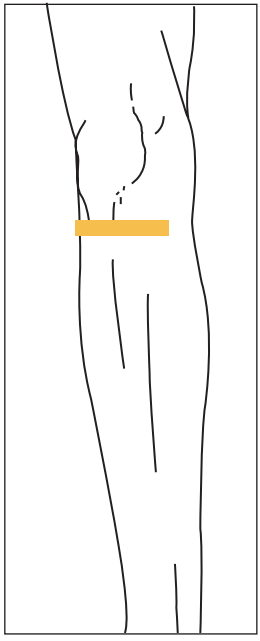

FIG. 229 TS, probe proximal to tibial tuberosity

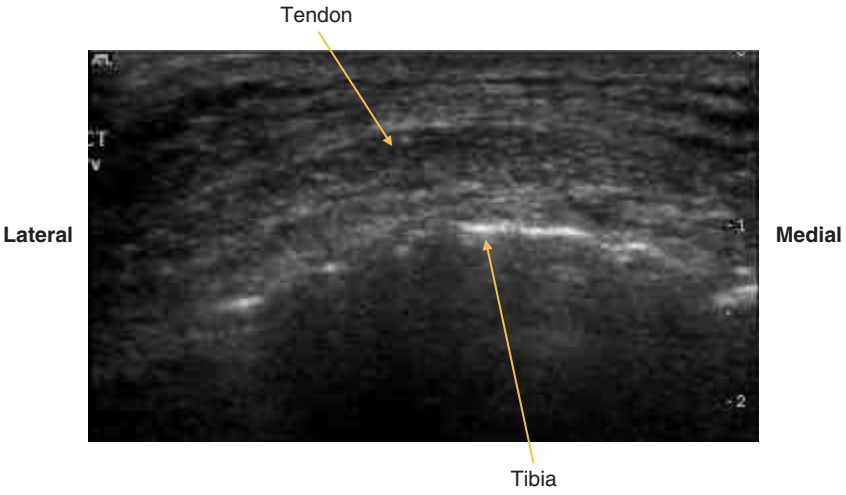

FIG. 230 TS, patellar tendon, tibial insertion

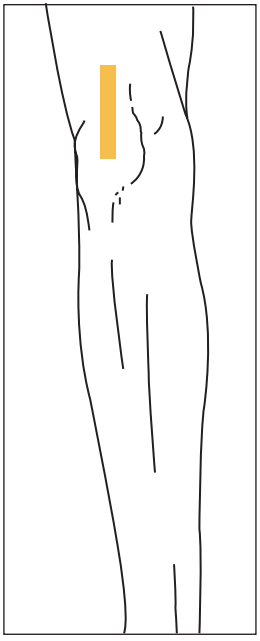

FIG. 231 LS quadriceps tendon, probe proximal to upper pole of patella

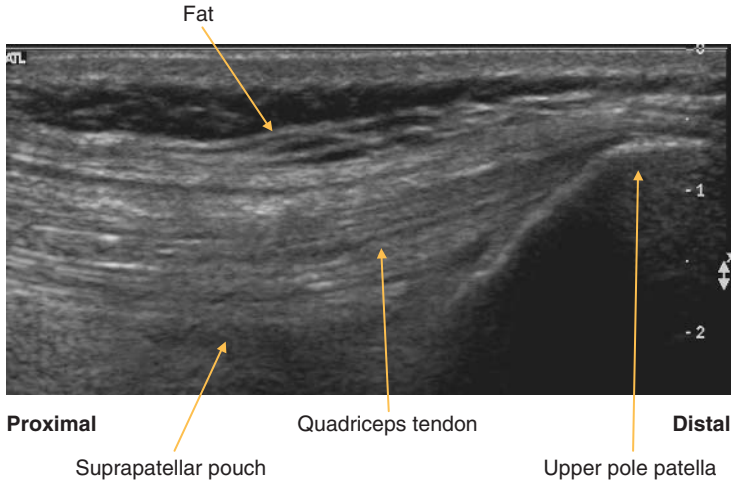

FIG. 232 LS, distal quadriceps tendon

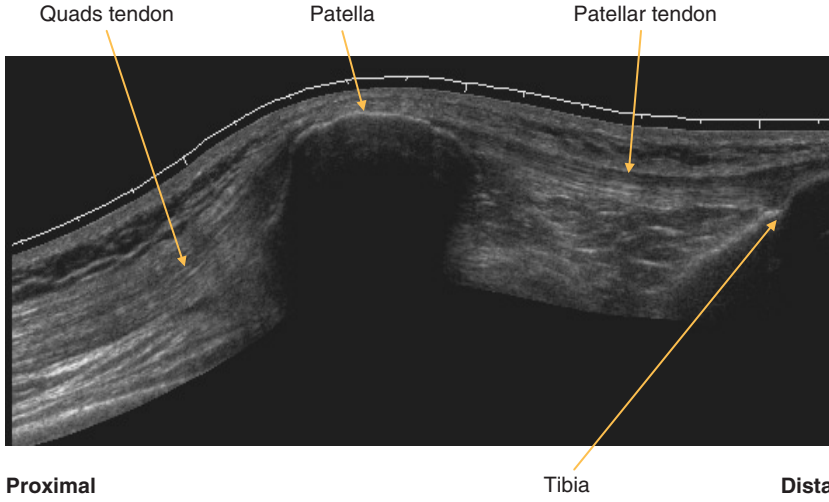

FIG. 233 LS panorama, extensor compartment

Anterior cruciate ligament

(Figures 234 and 235)

The anterior cruciate ligament (ACL) attaches on the antero-medial tibial intercondylar area and inserts on the medial surface of the lateral femoral condyle.

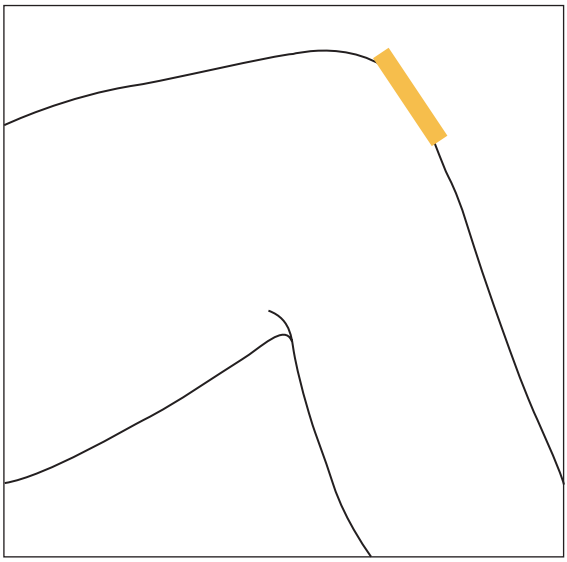

FIG. 234 LS ACL, probe midline over patellar tendon

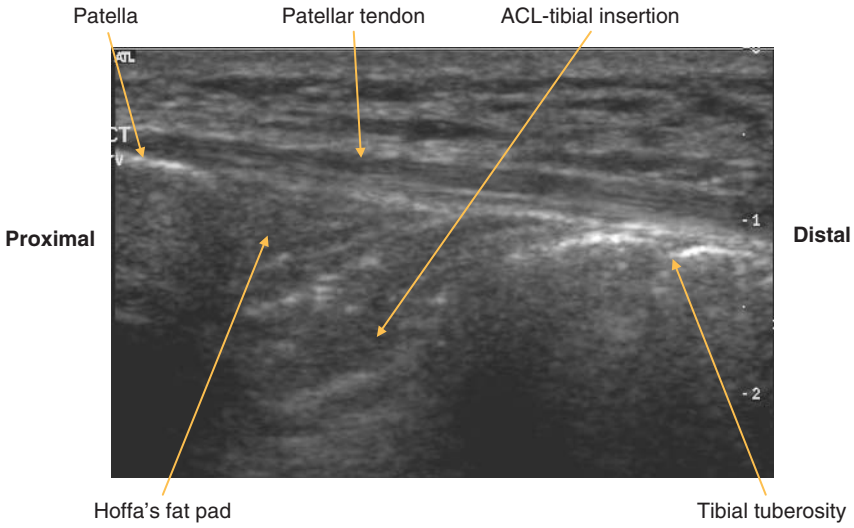

FIG. 235 LS of anterior knee, ACL

Trochlear groove

(Figures 236 and 237)

Notes

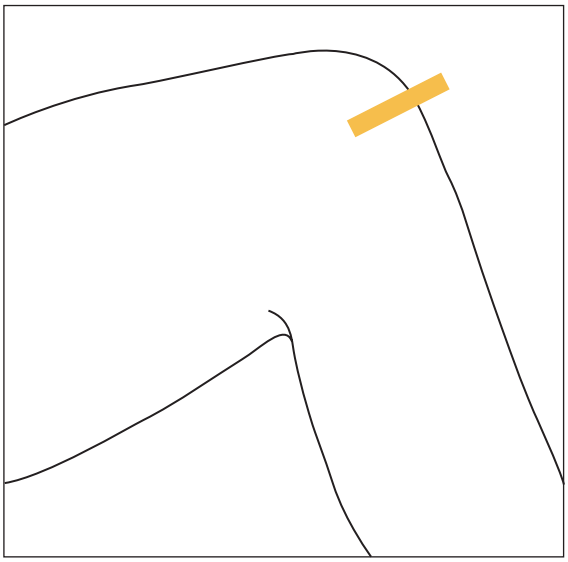

FIG. 236 TS, knee flexed, probe distal to patella

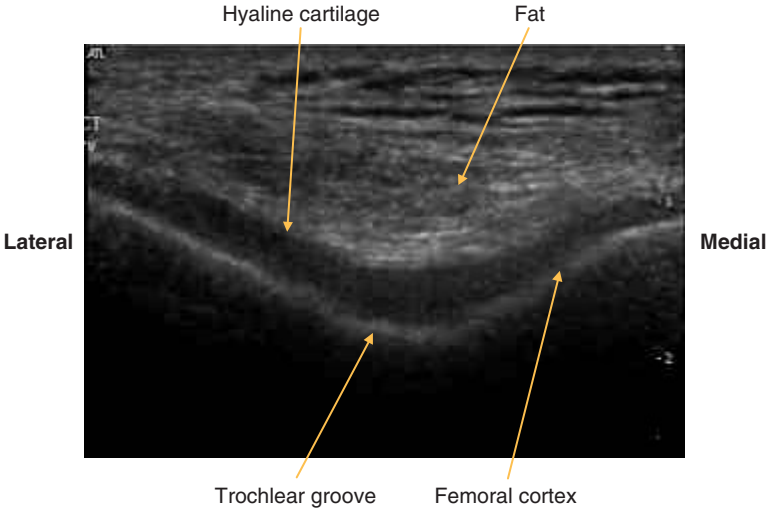

FIG. 237 TS, trochlear groove

Semimembranosus – inserts postero-medial tibial condyle

(Figures 238 and 239)

Notes

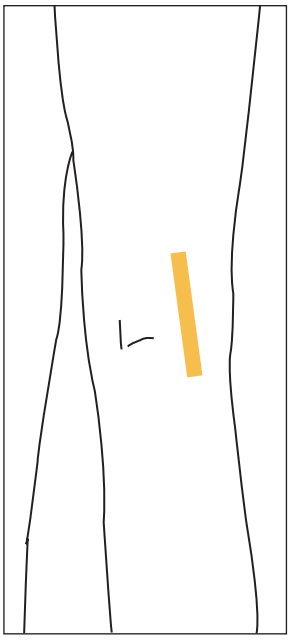

FIG. 238 LS, leg extended

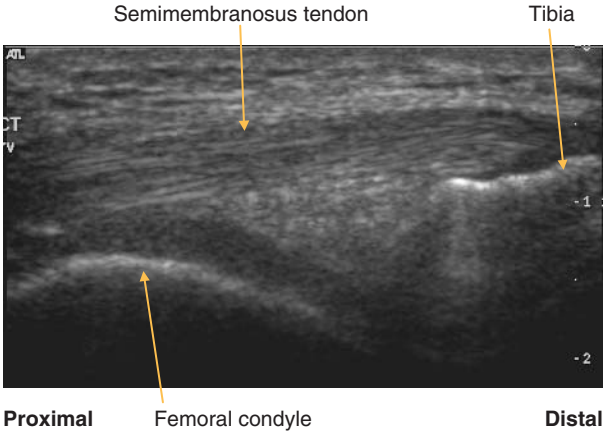

FIG. 239 LS, semimembranosus tendon

Pes anserinus

(Figures 240 and 241)

Insertion of sartorius, gracilis and semitendinosus. Semitendinosus inserts onto antero-medial tibia shaft, posterior to gracilis and sartorius. A bursa (anserine bursa) separates gracilis and semitendinosus from the tibia, with another bursa between them and sartorius.

Notes

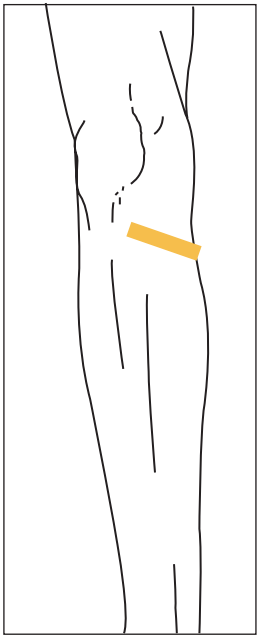

FIG. 240 TS, leg extended

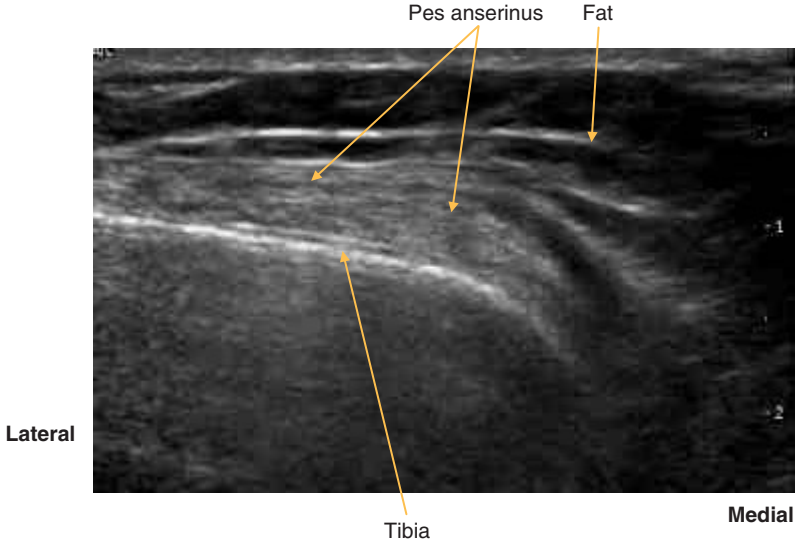

FIG. 241 TS, pes anserinus

Medial knee

Medial meniscus

(Figures 242–244)

Notes

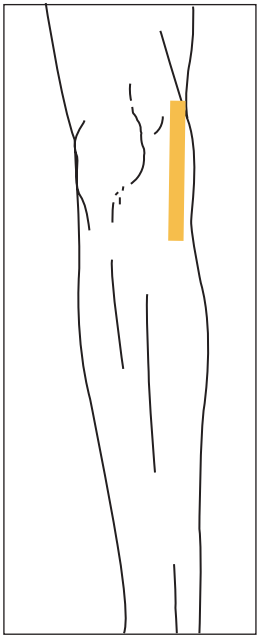

FIG. 242 LS, leg straight. Valgus strain may be applied to assess stability

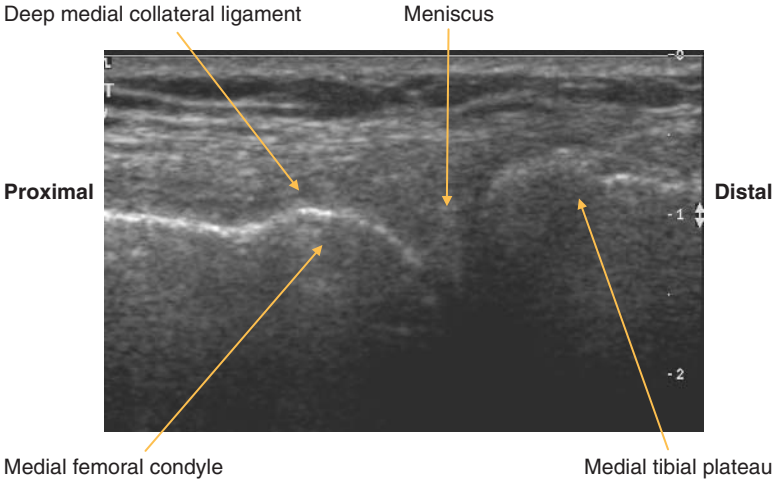

FIG. 243 LS, medial meniscus

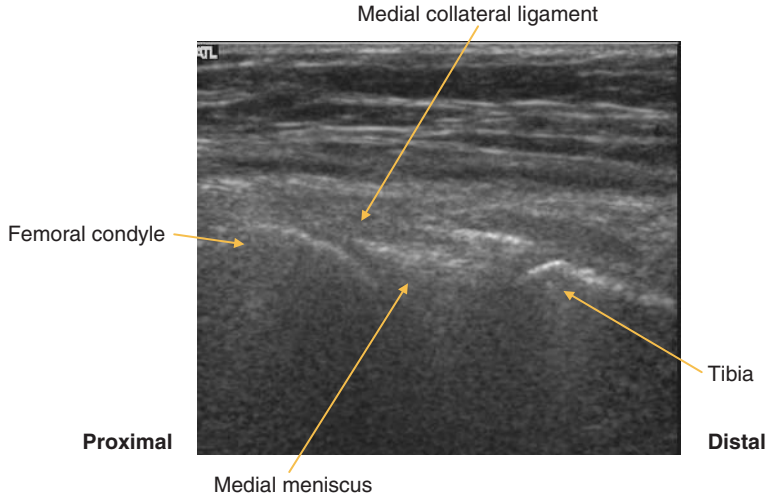

FIG. 244 LS, medial knee

Medial collateral ligament

(Figures 245–249)

Approximately 10 cm in length, arises from the medial femoral epicondyle and extends to the proximal medial tibial shaft. Deeper layer is attached to the medial tibial condyle and blends with the medial meniscus.

Notes

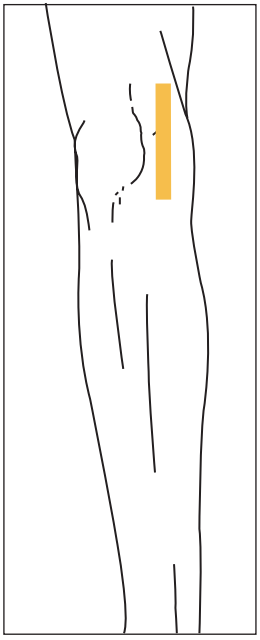

FIG. 245 LS, leg straight, apply valgus strrain for stability

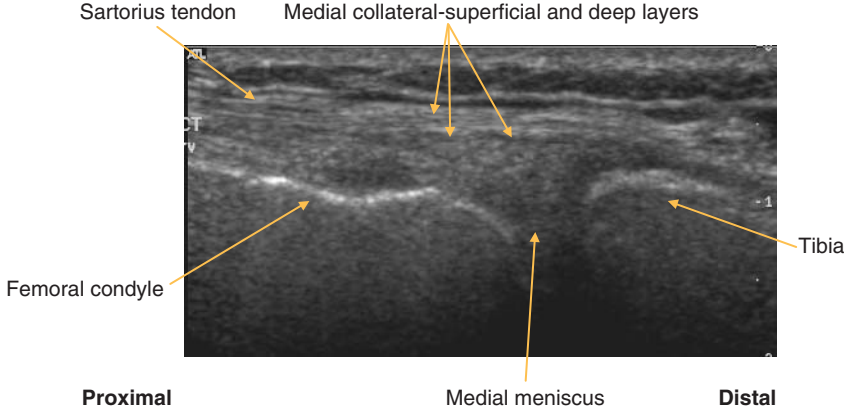

FIG. 246 LS, medial collateral ligament

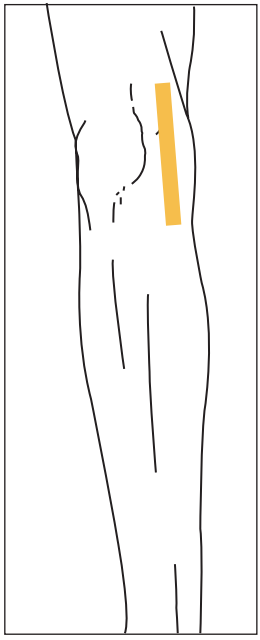

FIG. 247 LS panorama, medial knee

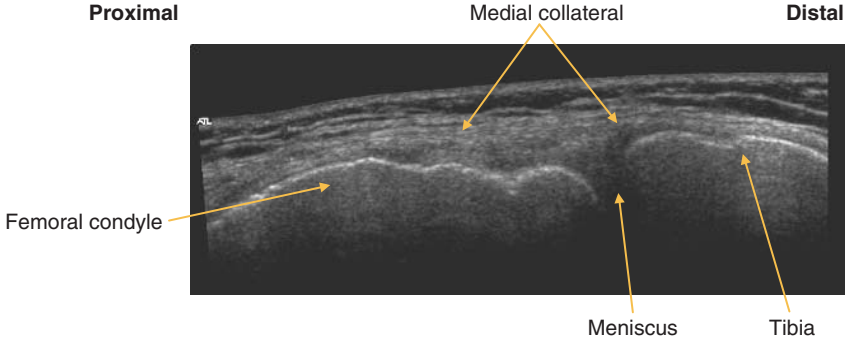

FIG. 248 LS, medial collateral ligament

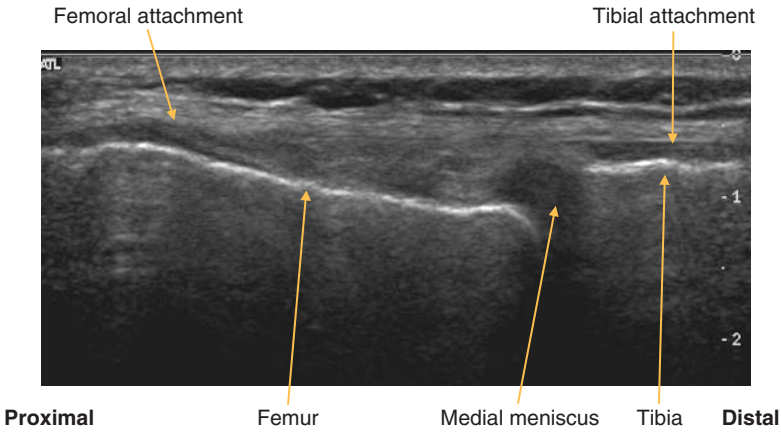

FIG. 249 LS, medial collateral ligament

Lateral knee

Lateral collateral ligament

(Figures 250–252)

The lateral collateral ligament arises from the lateral femoral epicondyle and extends to the apex of the fibula.

Notes

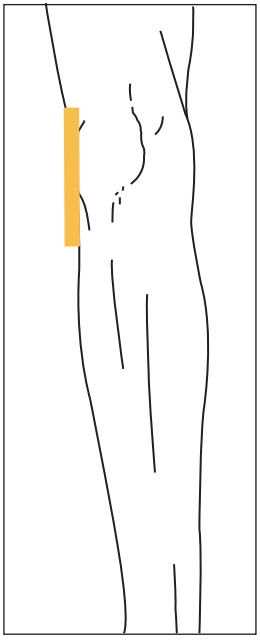

FIG. 250 LS, leg extended, probe over lateral knee

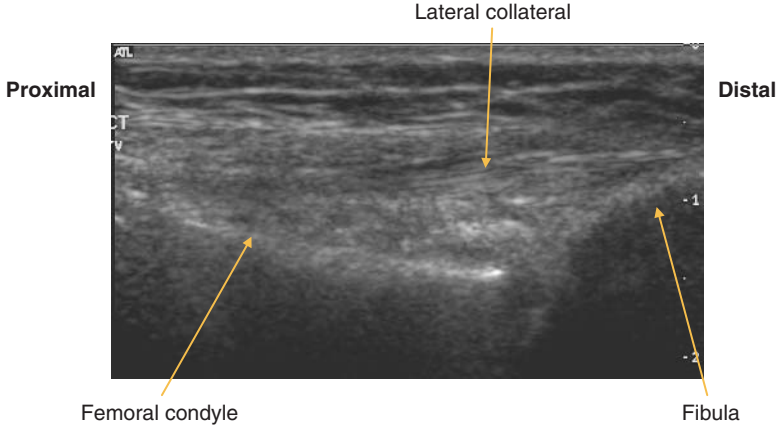

FIG. 251 LS, lateral collateral ligament

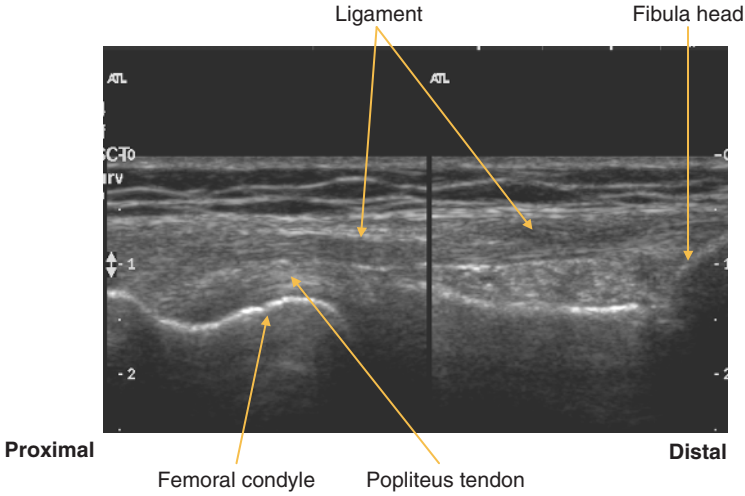

FIG. 252 LS, lateral collateral ligament, composite image

Common peroneal nerve

(Figures 253 and 254)

This is a terminal branch of the sciatic nerve formed just proximal to the popliteal fossa. It lies on the lateral head of gastrocnemius and then on the neck of the fibula and is deep to biceps femoris. It pierces peroneus longus to divide into superficial and deep branches.

Notes

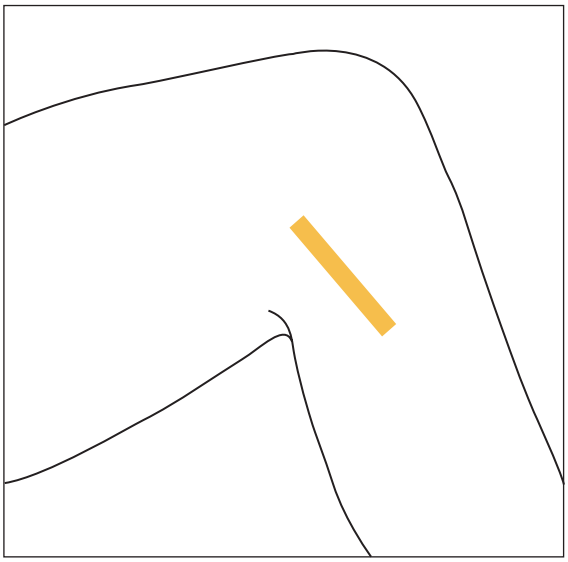

FIG. 253 TS, knee flexed, probe over fibula neck

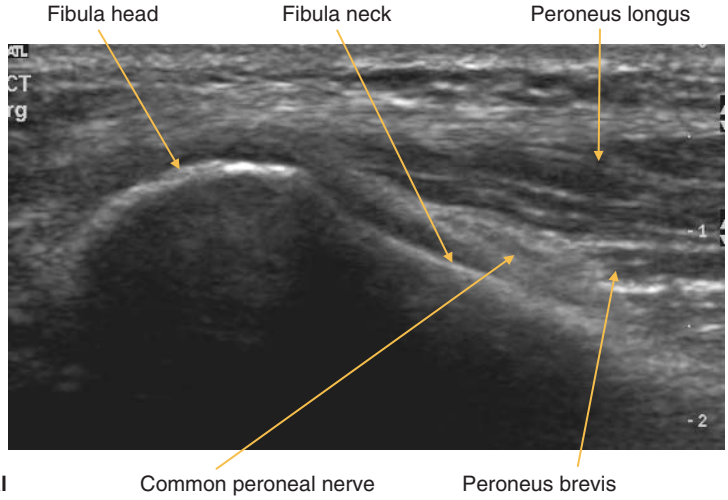

FIG. 254 TS, common peroneal nerve

Posterior knee

Popliteal fossa

(Figures 255 and 256)

Contents:

Popliteal artery and vein, and branches, tibial and common peroneal nerves, lymph nodes and fat.

Boundaries

- Lateral: biceps.
- Medial: semitendinosus, semimembranosus.
- Inferior: medial and lateral heads of gastrocnemius.

Posterior cruciate ligament

The posterior cruciate ligament (PCL) extends from lateral surface of medial femoral condyle to posterior intercondylar area of tibia.

Notes

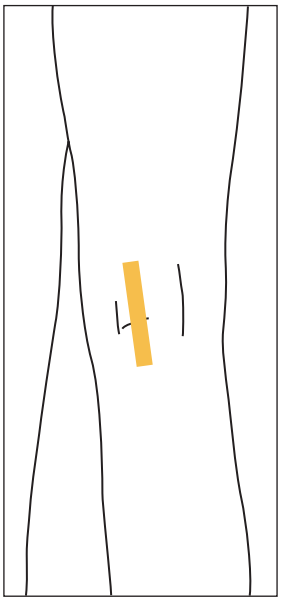

FIG. 255 LS, posterior knee, medial popliteal fossa

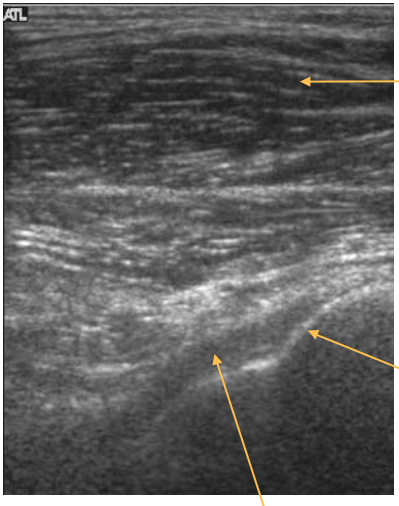

FIG. 256 LS, posterior cruciate ligament

Lateral popliteal fossa

(Figures 257–260)

Biceps femoris attaches to apex of fibula.

Popliteus tendon arises from the lateral femoral epicondyle, and is attached to the lateral meniscus. The muscle attaches to the posterior tibia proximal to the soleal line. Popliteus bursa lies between the muscle and tibia.

Notes

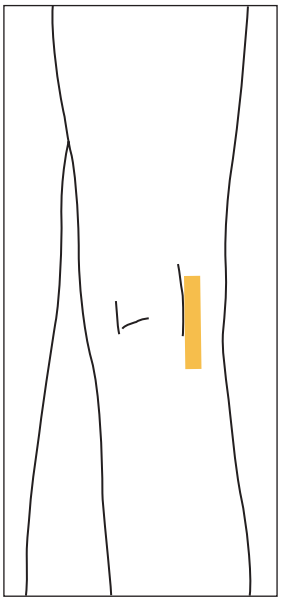

FIG. 257 LS, probe over lateral popliteal fossa. Biceps femoris insertion normally appears slightly hypo-echoic and expanded

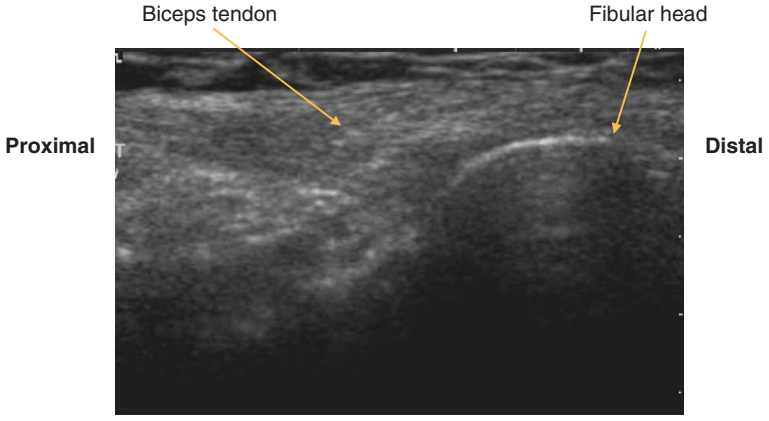

FIG. 258 LS, biceps

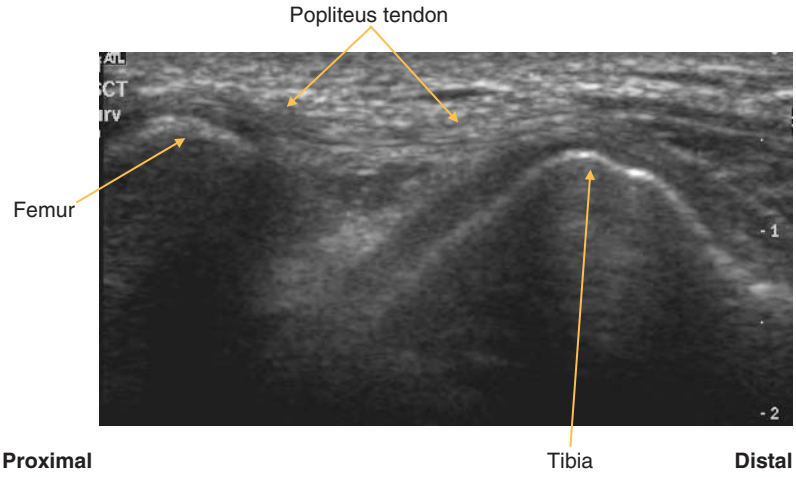

FIG. 259 LS, popliteus tendon

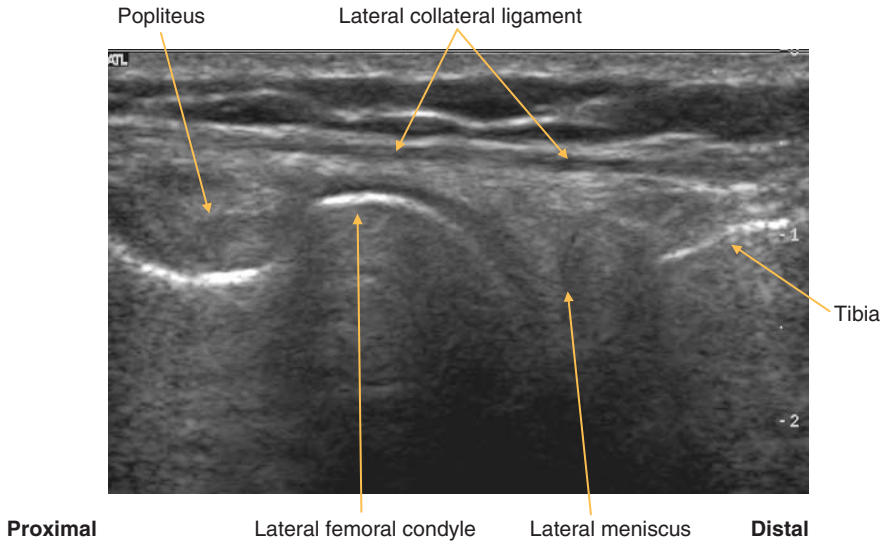

FIG. 260 LS, posterolateral knee

Popliteal fossa "cyst space"

(Figures 261 and 262)

Cyst neck lies between medial head of gastrocnemius and semimembranosus tendon.

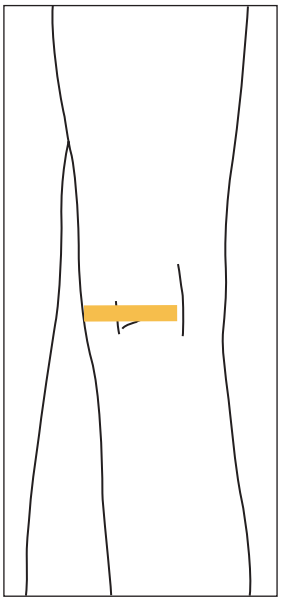

FIG. 261 TS, probe over medial head of gastrocnemius

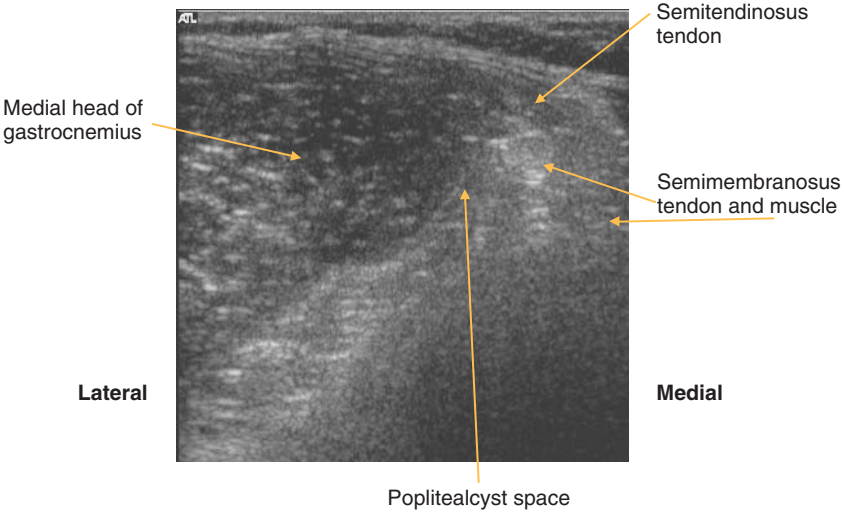

FIG. 262 TS, popliteal cyst space

Panorama of the popliteal fossa

(Figures 263 and 264)

Notes

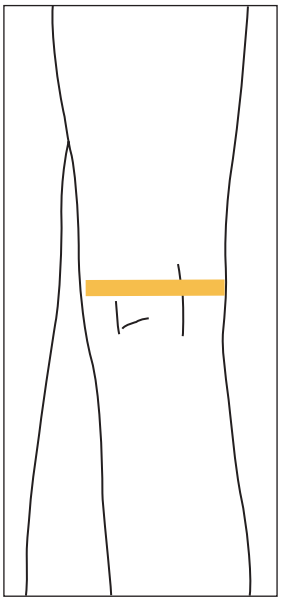

FIG. 263 TS panorama, popliteal fossa

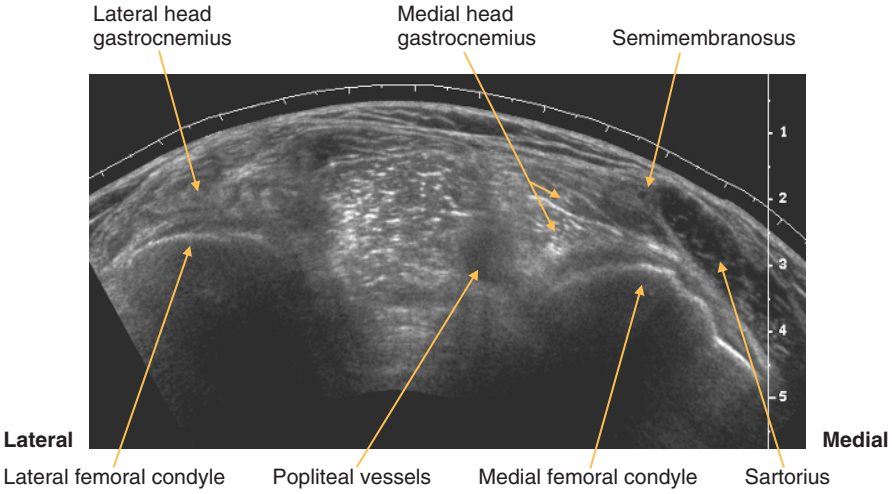

FIG. 264 TS panorama, popliteal fossa

Calf

Anterior, lateral and posterior compartments divided by tibia, interosseous membrane, and anterior and posterior intermuscular septa. The anterior septum passes to the anterior border of the fibula and separates the anterior (dorsi-flexor) from the lateral (evertor) compartment.

Anterior compartment

(Figures 265 and 266)

- Tibialis anterior
  - Origin: proximal two-thirds of tibia.
  - Insertion: medial cuneiform and first metatarsal.
- Extensor hallucis longus
  - Origin: anterior proximal fibula.
  - Insertion: distal phalanx great toe.
- Extensor digitorum longus
  - Origin: anterior proximal fibula.
  - Insertion: dorsum of middle and terminal phalanges.
- Peroneus tertius
  - Origin: lower anterior fibula.
  - Insertion: fifth metatarsal.

Notes

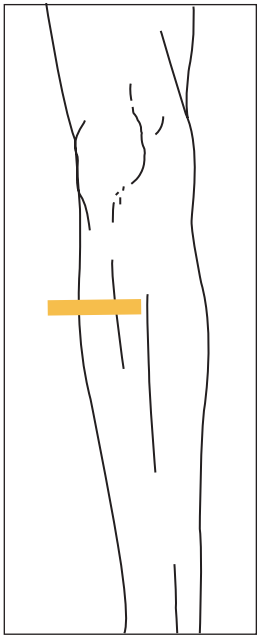

FIG. 265 TS, probe lateral to tibia

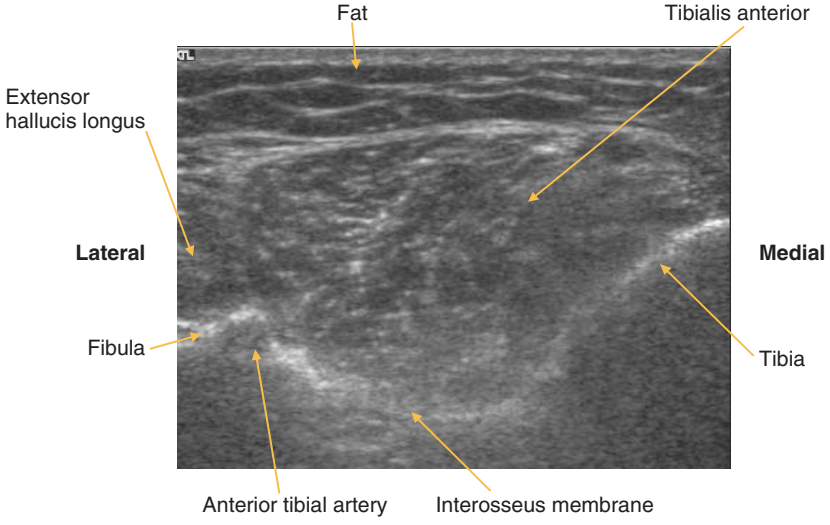

FIG. 266 TS, mid-calf ant/lat

Lateral compartment

(Figures 267–270)

- Peroneus longus
  - Origin: proximal lateral fibula.
  - Insertion: first metatarsal and medial cuneiform.
- Peroneus brevis
  - Origin: lower lateral fibula.
  - Insertion: fifth metatarsal.

Notes

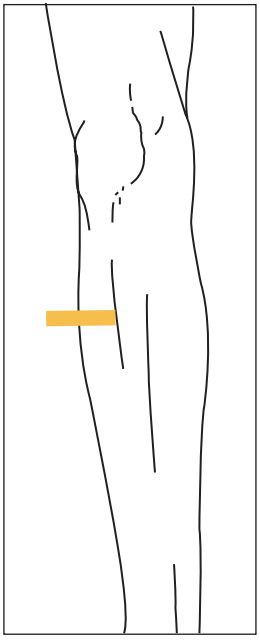

FIG. 267 TS, probe lateral to fibula, mid-calf

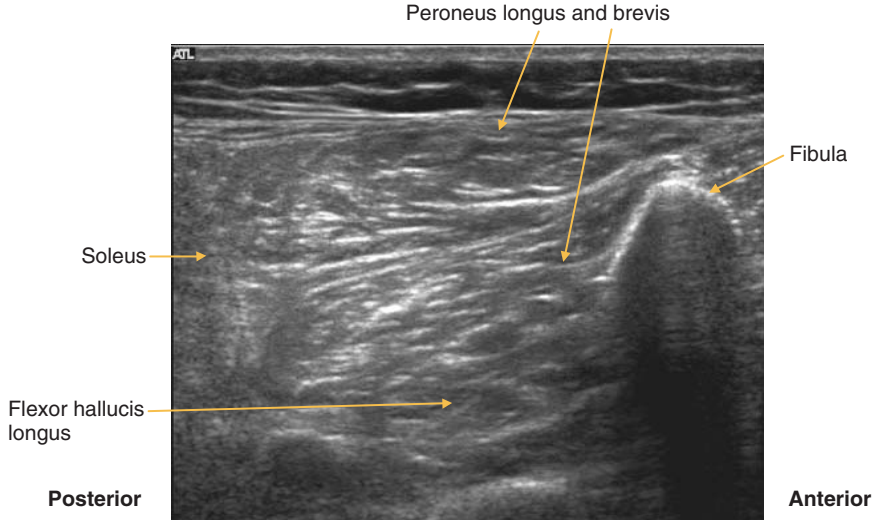

FIG. 268 TS, peroneal compartment

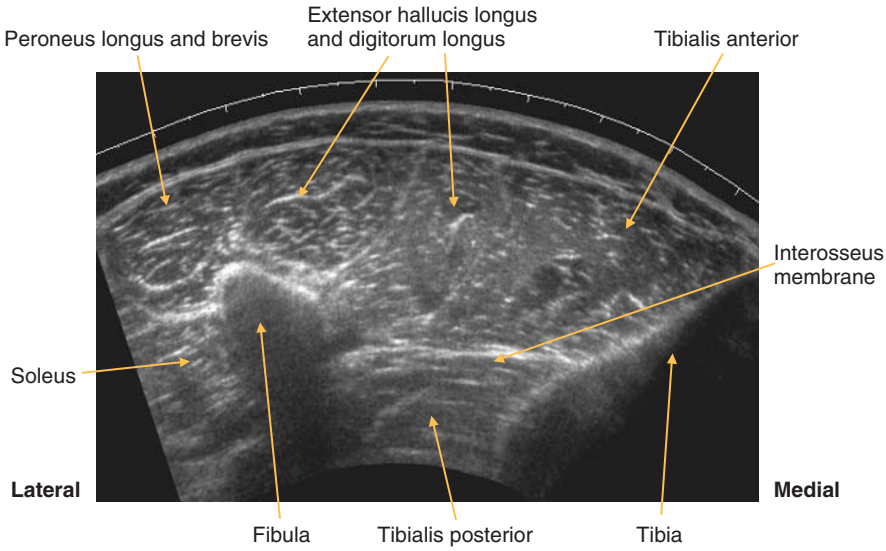

FIG. 269 TS panorama, antero-lateral calf

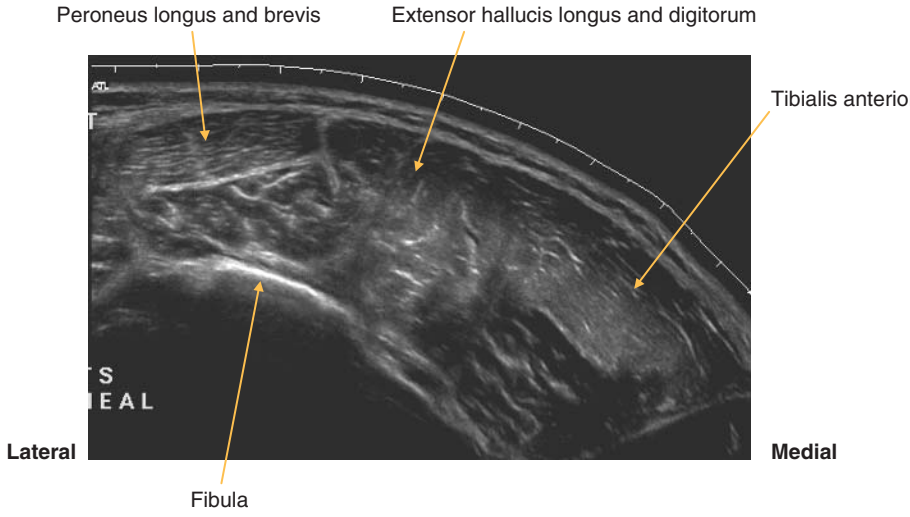

FIG. 270 TS panorama, peroneal compartment

Posterior compartment

(Figures 271–275)

Superficial muscles

- Gastrocnemius
  - Origin: medial and lateral femoral condyles.
  - Insertion: soleus and tendo-achilles.

- Soleus
  - Origin: soleal line tibia and posterior fibula.
  - Insertion: tendo-achilles.
- Plantaris
  - Origin: lateral supracondylar line.
  - Insertion: tendo-achilles.

Deep muscles

- Popliteus
  - Origin: posterior tibia proximal to soleal line.
  - Insertion: lateral femoral epicondyle.
- Flexor digitorum longus
  - Origin: medial posterior tibia.
  - Insertion: terminal phalanges lateral four toes.
- Tibialis posterior
  - Origin: posterior interosseus membrane, tibia and fibula.
  - Insertion: navicular.
- Flexor hallicus longus
  - Origin: posterior distal fibula.
  - Insertion: distal phalanx great toe.

Notes

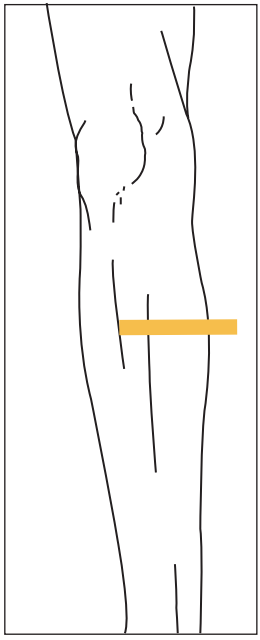

FIG. 271 TS, probe medial to tibia

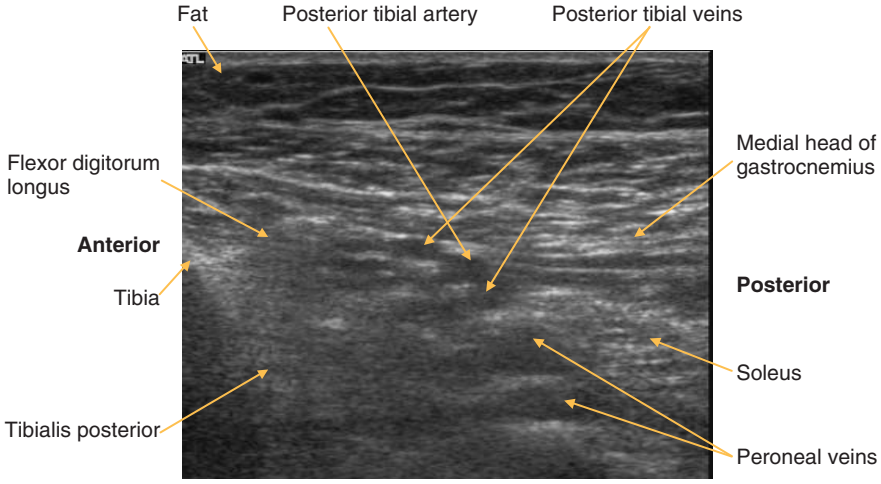

FIG. 272 TS, mid-calf – medial

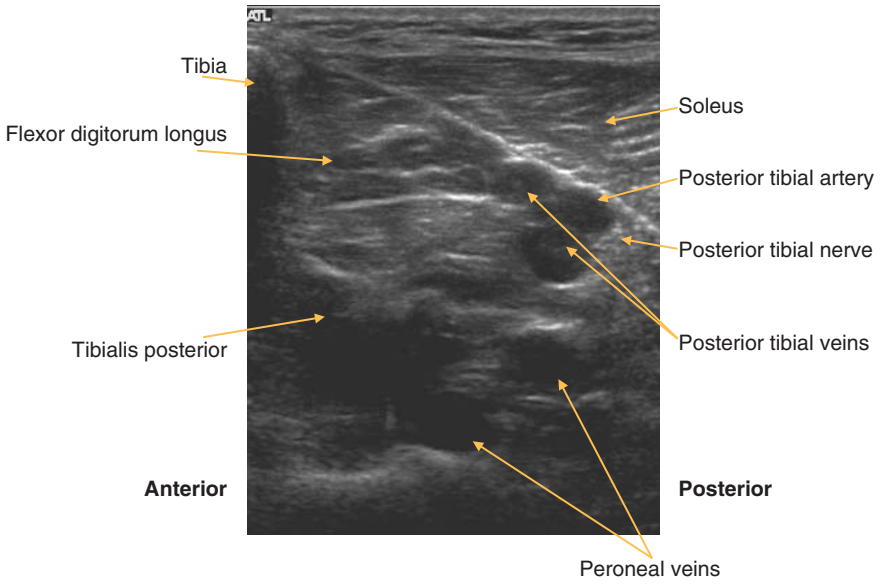

FIG. 273 TS, medial calf

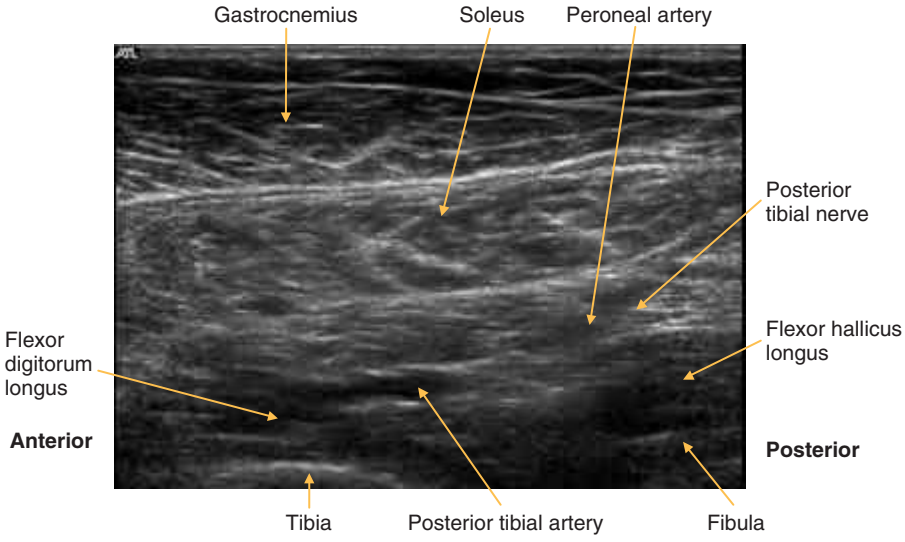

FIG. 274 TS, proximal posterior calf

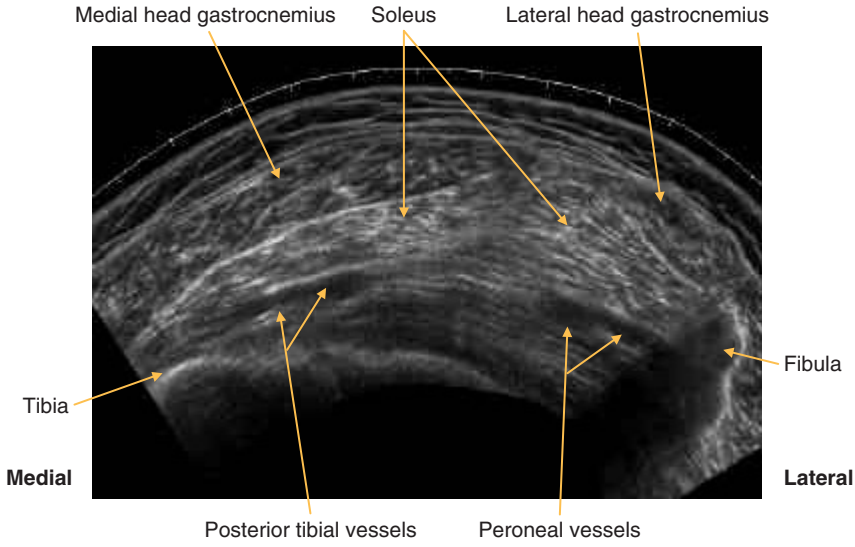

FIG. 275 TS panorama, posterior calf

Posterior calf (popliteal fossa)

(Figures 276 and 277)

Notes

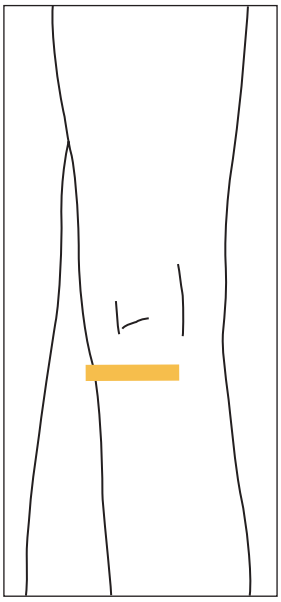

FIG. 276 TS, patient prone

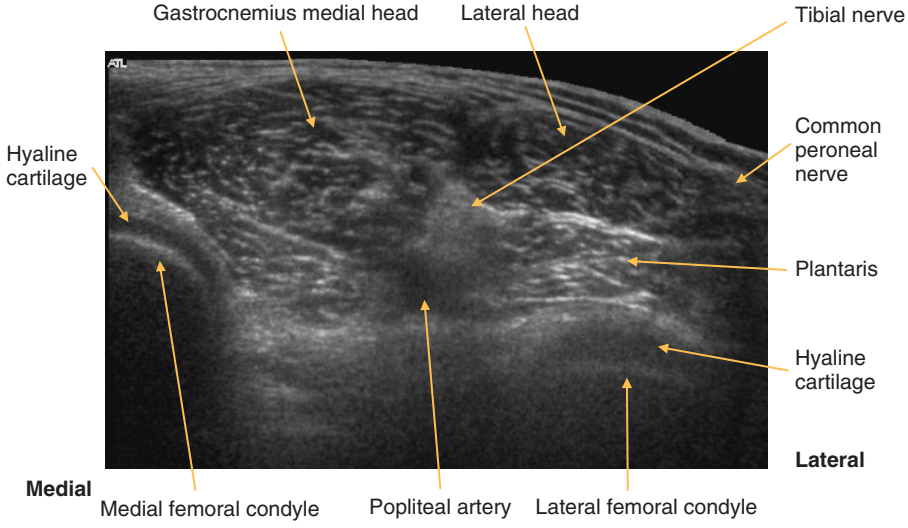

FIG. 277 TS, proximal gastrocnemius

Ankle

Ankle: posterior

(Figure 278–285)

Tendo-achilles: formed by gastrocnemius and soleus to attach distally to the posterior superior calcaneum. There is no synovial sheath but it has an hyperechoic paratenon. Deep to distal tendon is Kager's fat pad and pre-achilles bursa. Retro-calcaneal bursa lies posterior to the tendon attachment.

Notes

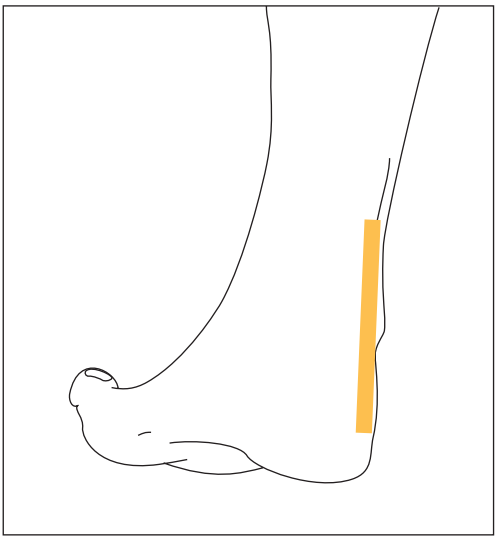

FIG. 278 LS, patient prone. Stand-off medium is sometimes useful. Dynamic examination should be performed by passively and actively dorsi- and plantar-flexing the foot. Dorsi-flexion straightens the tendon to avoid anisotropy

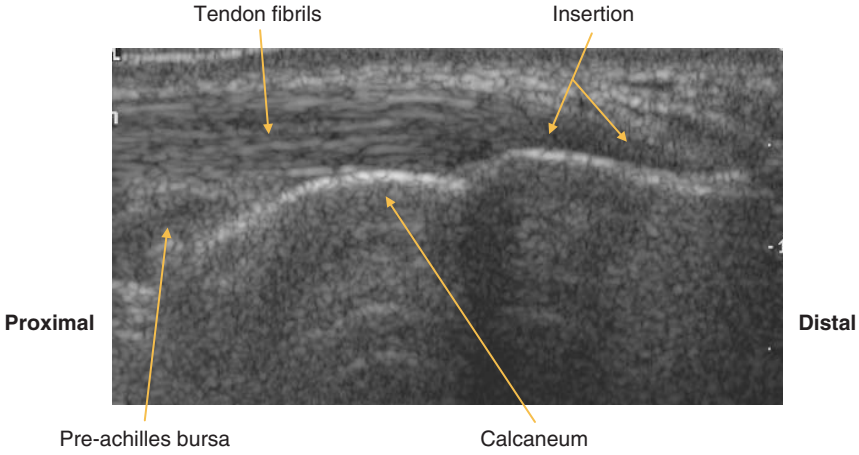

FIG. 279 LS, distal tendo-achilles insertion

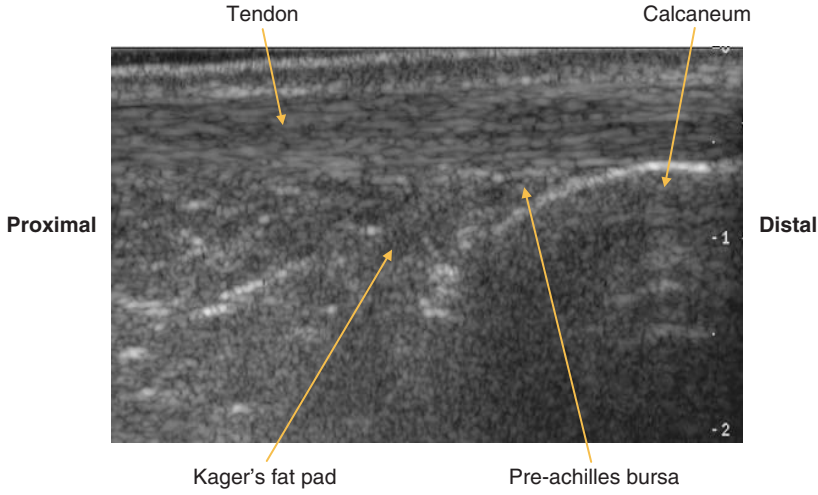

FIG. 280 LS, body of tendo-achilles

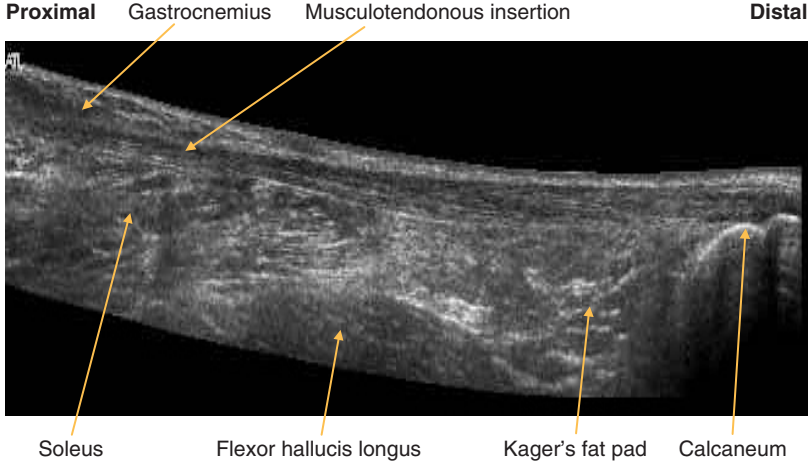

FIG. 281 LS, panorama of tendo-achilles

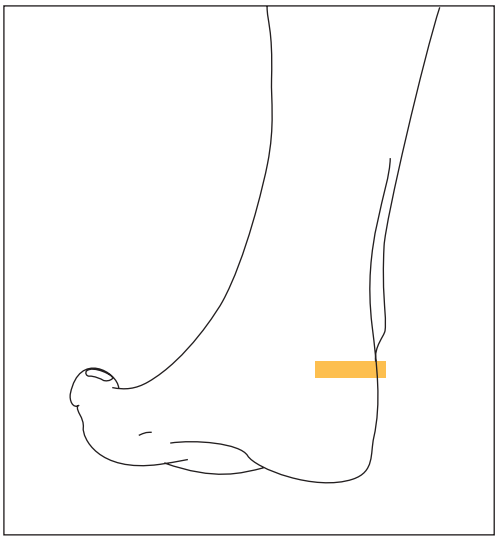

FIG. 282 TS, prone with probe over tendo-achilles. Angle medially and laterally for paratenon

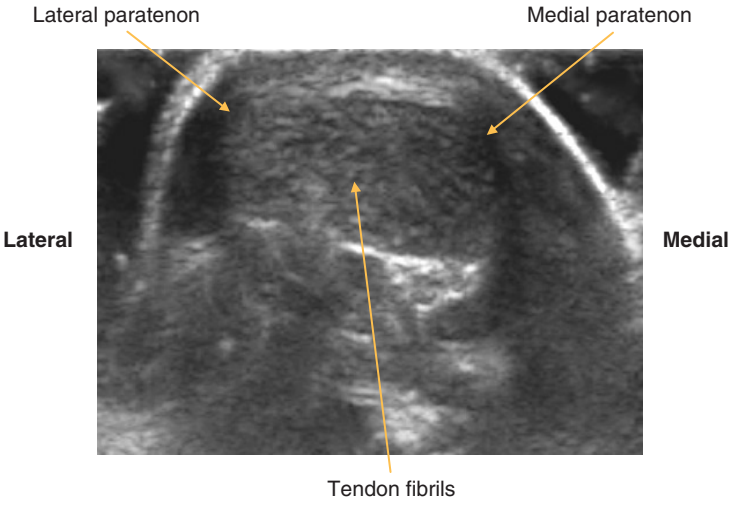

FIG. 283 TS, tendo-achilles. Due to edge effect, the medial and lateral paratenon is difficult to visualize unless the probe is angled to assess them individually

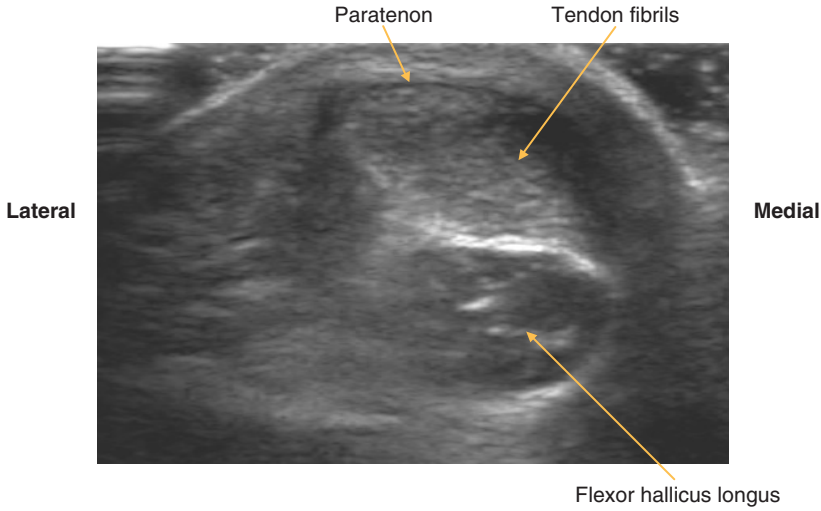

FIG. 284 TS, lateral paratenon. A stand-off pad is often helpful for assessment of the tendo-achilles

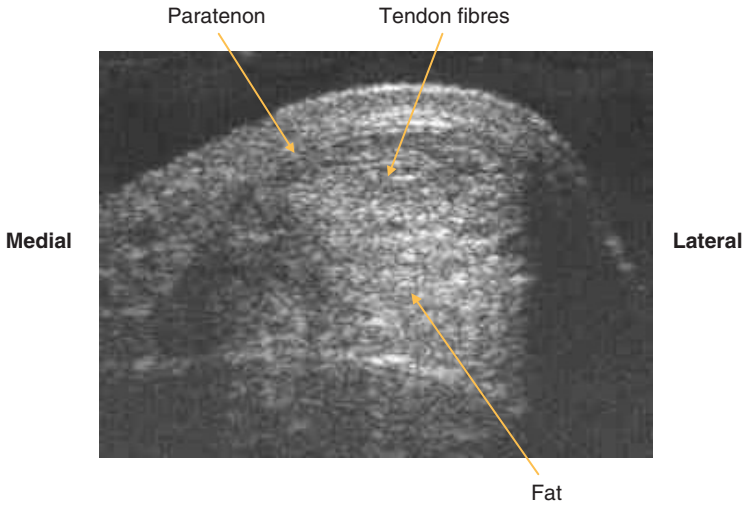

FIG. 285 TS, distal tendo-achilles

Ankle: lateral

Ligaments – antero-lateral complex composed of three separate parts:

- calcaneo-fibular,
- posterior talo-fibular and
- anterior talo-fibular ligaments.

Calcaneo-fibular ligament

(Figures 286 and 287)

Passes posteriorly from the tip of the lateral malleolus to the lateral border of the calcaneum.

Posterior talo-fibular ligament

Posterior talo-fibular is not successfully imaged on ultrasound.

Notes

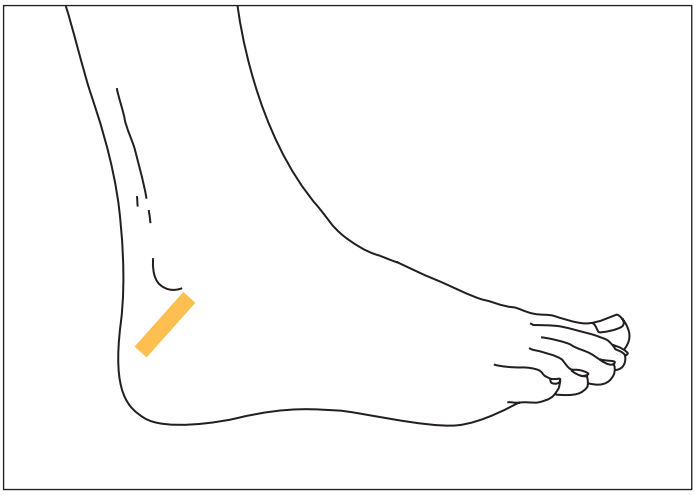

FIG. 286 LS, foot may be internally rotated, probe posterior and inferior to lateral malleolus. Foot eversion and inversion for dynamic examination

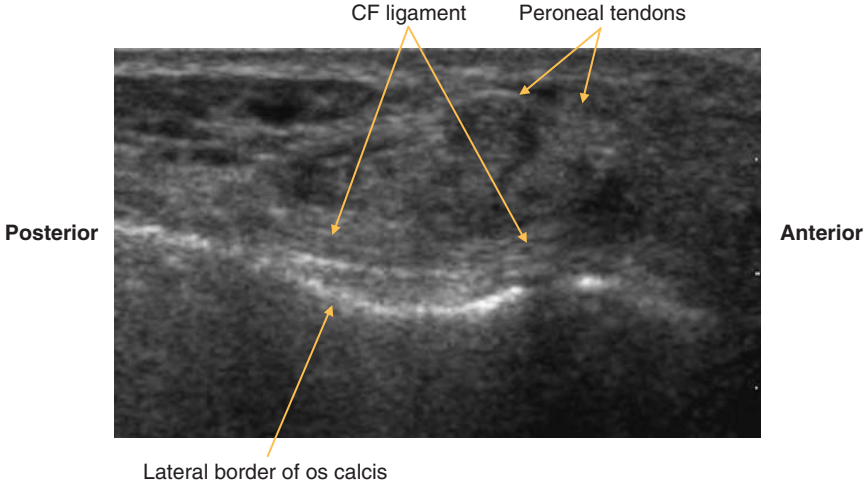

FIG. 287 LS, calcaneo-fibular ligament

Anterior talo-fibular ligament

(Figures 288 and 289)

Passes horizontally from lateral malleolus to neck of talus. Foot eversion and inversion for dynamic examination.

Notes

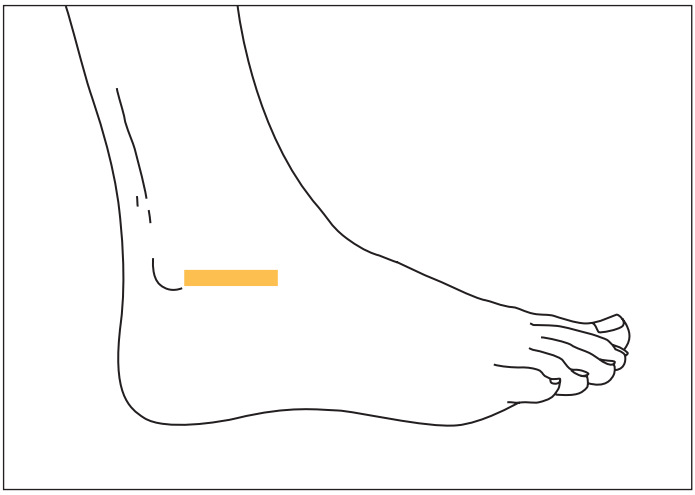

FIG. 288 LS, probe anterior and inferior to lateral malleolus

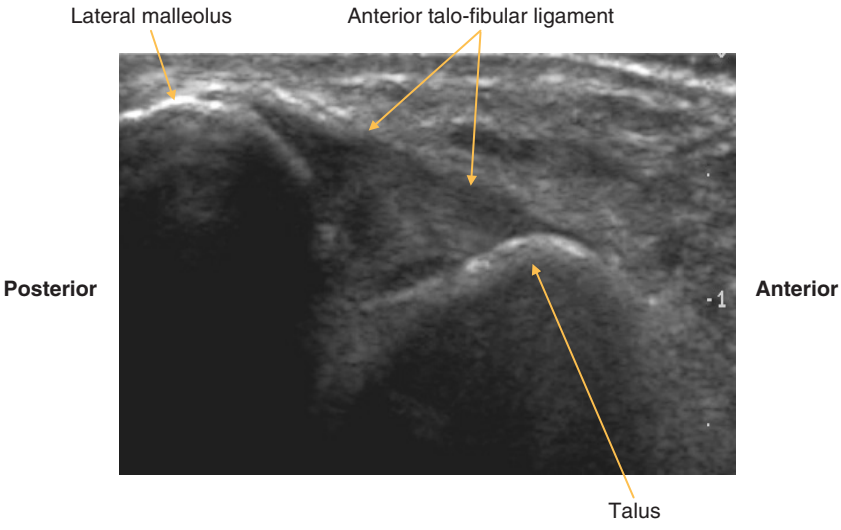

FIG. 289 LS, anterior talo-fibular ligament

Tendons

(Figures 290 and 291)

Peroneus longus and brevis. Brevis is first medial, then anterior to longus and both should be posterior to the lateral malleolus.

- Peroneus longus
  - Origin: proximal lateral fibula.
  - Insertion: first metatarsal and medial cuneiform.
- Peroneus brevis
  - Origin: distal lateral fibula.
  - Insertion: fifth metatarsal.

Notes

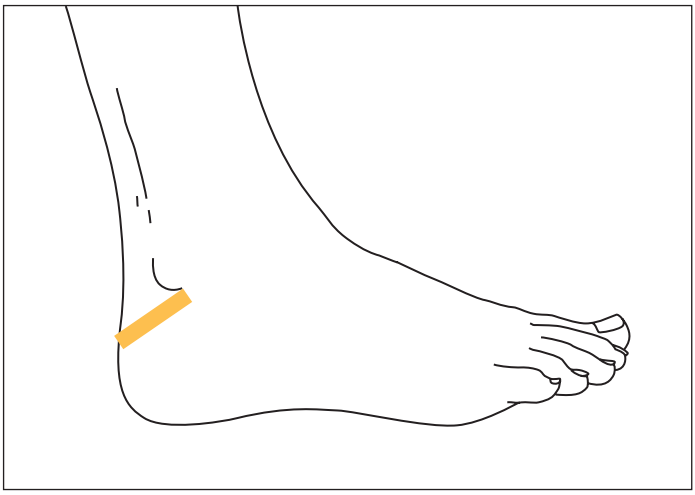

FIG. 290 TS, probe posterior and inferior to lateral malleolus. Plantar-flexing the foot can "straighten" the tendons. Dynamic examination using foot inversion and eversion

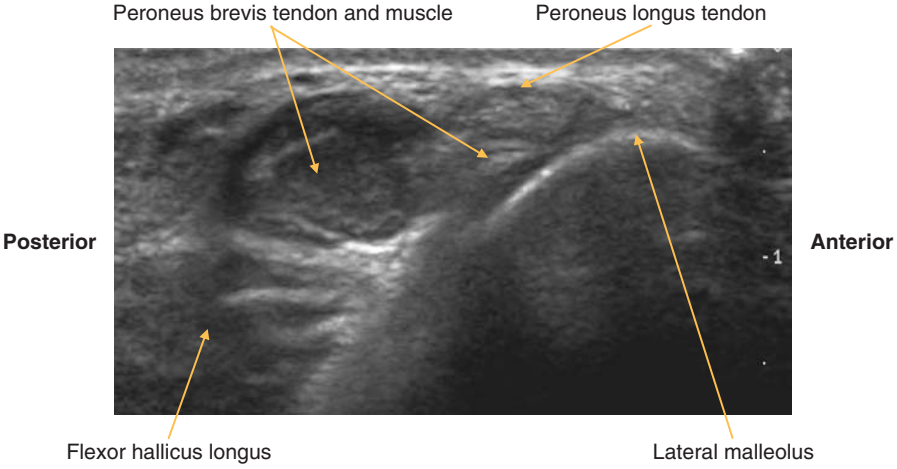

FIG. 291 TS, peroneal tendons

Distal peroneus brevis insertion

(Figures 292 and 293)

Notes

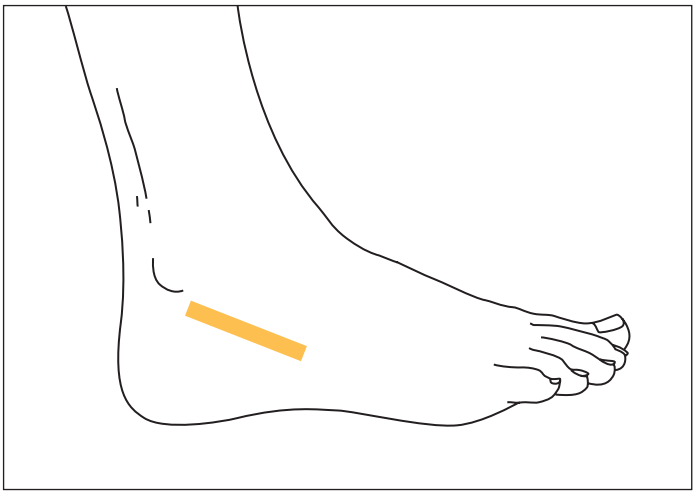

FIG. 292 LS, probe over base of fifth metatarsal

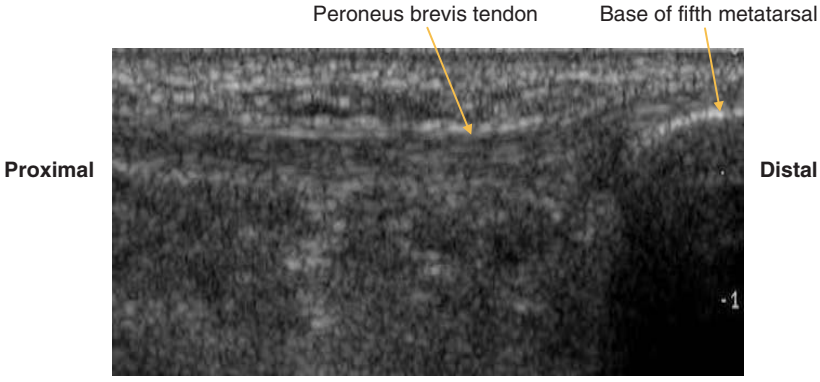

FIG. 293 LS, peroneus brevis insertion

Ankle: medial

Ligaments: deltoid

(Figures 294 and 295)

Deltoid ligament: Triangular shaped with deep and superficial layers. The superficial part attaches to the sustentaculum tali. The deep layer extends to the navicular and neck of talus.

Notes

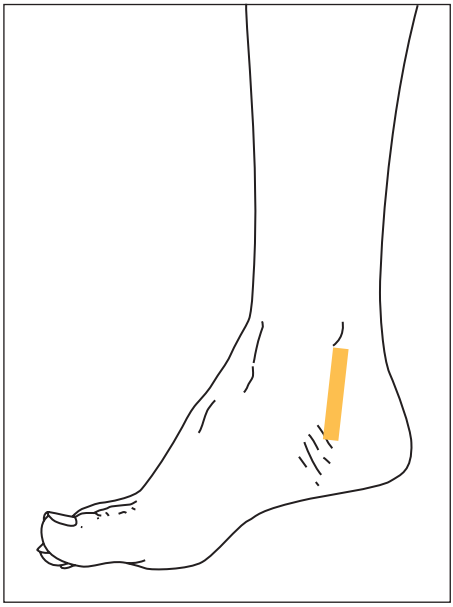

FIG. 294 LS, probe inferior to medial malleolus

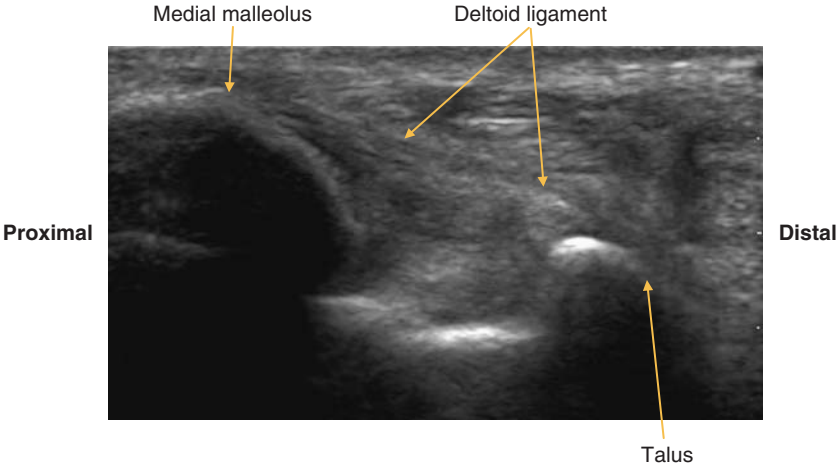

FIG. 295 LS, deltoid ligament

Tendons

(Figures 296–299)

Tibialis posterior, flexor digitorum longus, flexor hallucis longus from anterior to posterior.

- Tibialis posterior
  - Origin: posterior interosseous membrane, tibia and fibula.
  - Insertion: navicular.
- Flexor digitorum longus
  - Origin: medial posterior tibia.
  - Insertion: terminal phalanges lateral four toes.
- Flexor hallucis longus
  - Origin: posterior distal fibula.
  - Insertion: distal phalanx great toe.

Posterior tibial nerve: divides into lateral and medial plantar nerves.

- Lateral plantar – under flexor retinaculum passes along the sole of the foot to the fifth metatarsal. Sensory innervation lateral foot and toes, motor to intrinsic foot muscles.
- Medial plantar – under flexor retinaculum to sole. Sensory and motor to medial sole and toes.

Notes

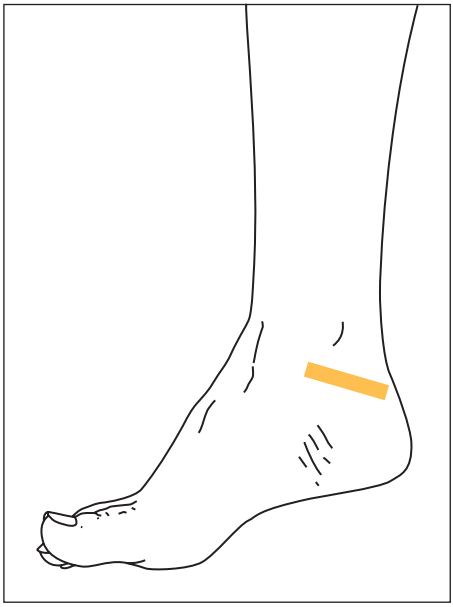

FIG. 296 TS, probe over medial malleolus. Dynamic examination using foot inversion/eversion

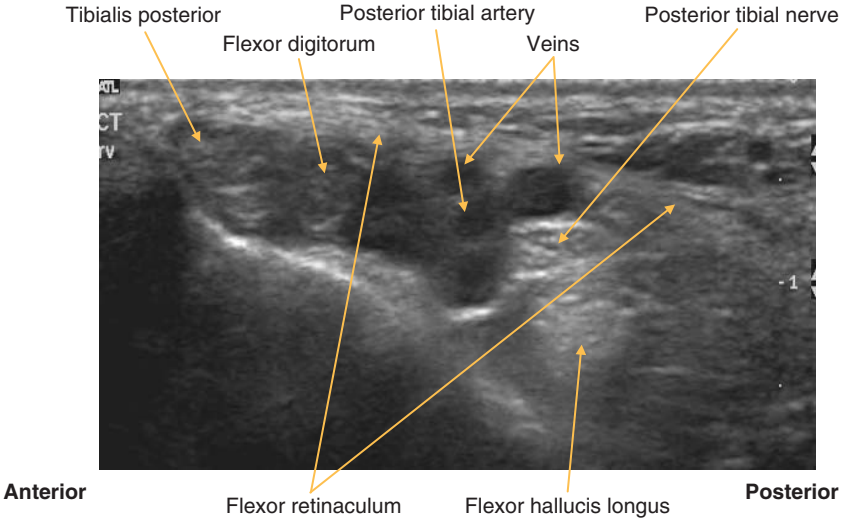

FIG. 297 TS, medial ankle

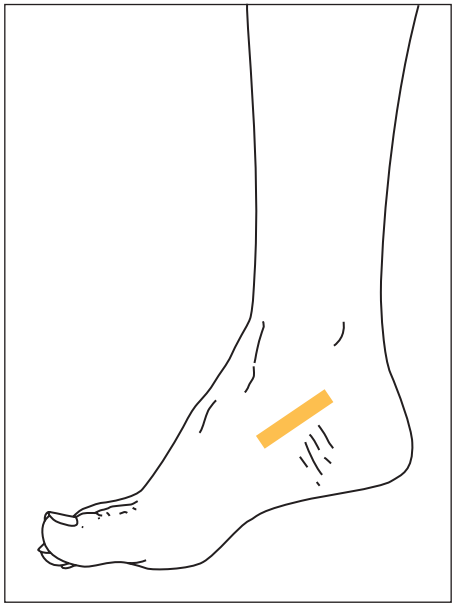

FIG. 298 LS, probe over navicular. Distal attachment always appears more ill defined, expanded and hypo-echoic compared to the rest of the tendon

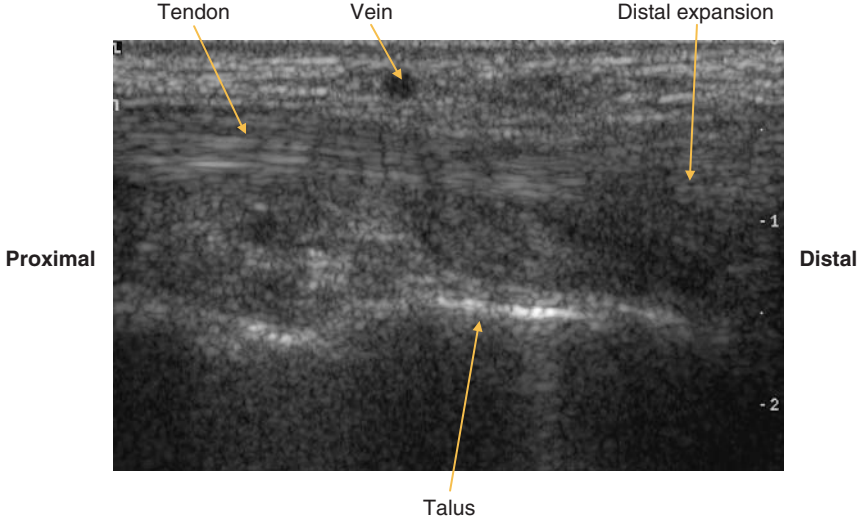

FIG. 299 LS, distal tibialis posterior insertion

Foot

(Figures 300 and 301)

- Plantar surface and sole of foot.
- Web space.

Contents: Flexor digitorum brevis and longus, quadratus plantae, lumbricals, flexor hallucis longus, abductor hallucis and interossei.

Notes

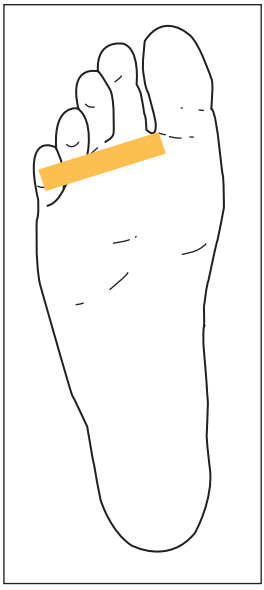

FIG. 300 TS web space, probe on plantar surface

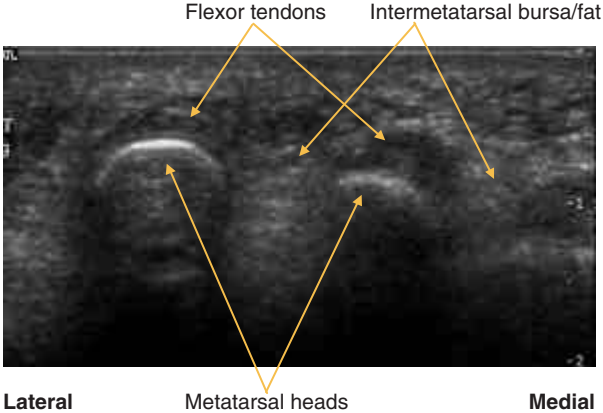

FIG. 301 TS, web space

Flexor hallucis longus

(Figures 302–305)

Tendon passes distally between the sesamoid bones and inserts in to the distal phalanx of the great toe.

Notes

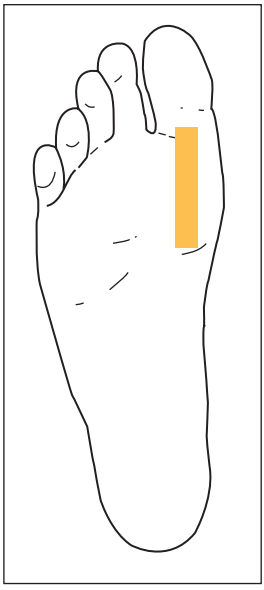

FIG. 302 LS, probe over first metatarsal head. Dynamic examination using flexion/extension of the great toe

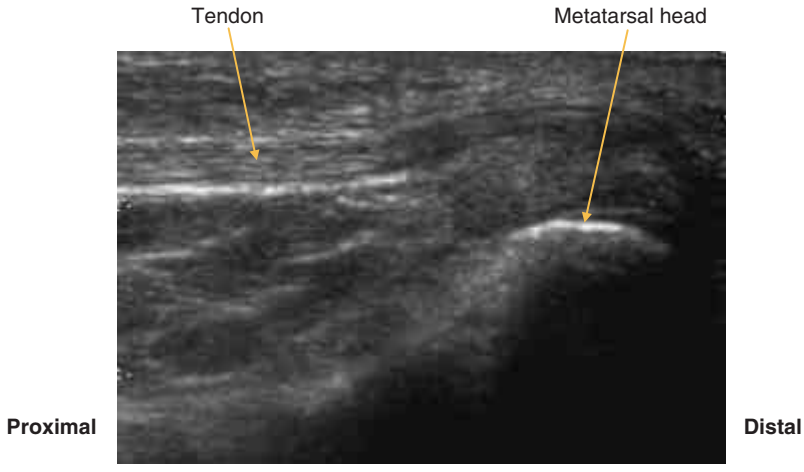

FIG. 303 Flexor hallucis longus in forefoot

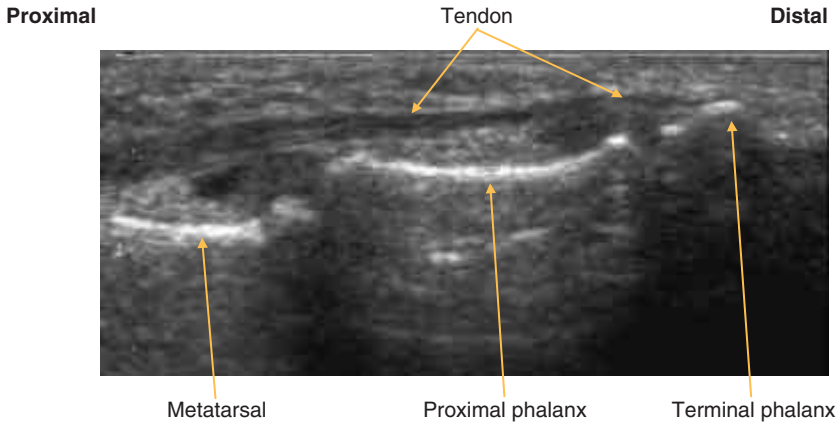

FIG. 304 LS, flexor hallucis longus

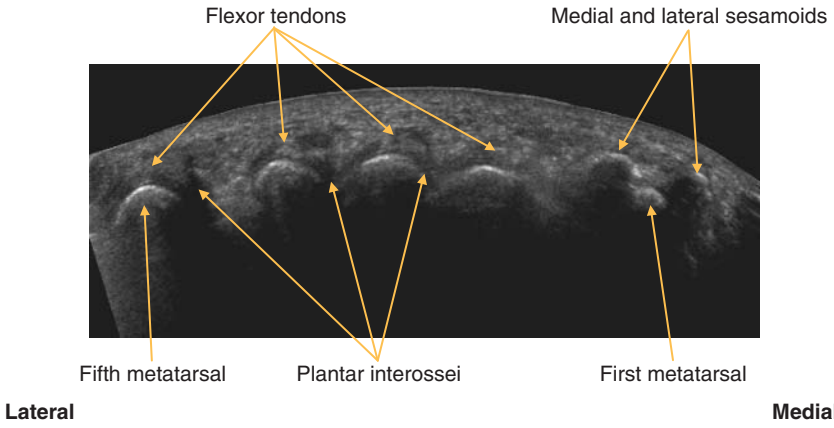

FIG. 305 TS panorama, plantar foot – metatarsals

Flexor hallucis brevis

(Figures 306–311)

- Origin: medial plantar surface of the cuboid and lateral cuneiform.
- Insertion: splits in two around flexor hallucis longus and inserts either side into the proximal phalanx. Each tendon contains a sesamoid bone.

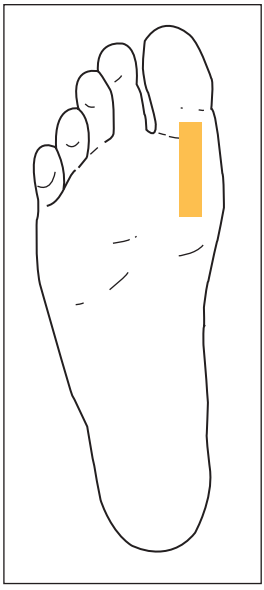

FIG. 306 LS, probe over medial sesamoid

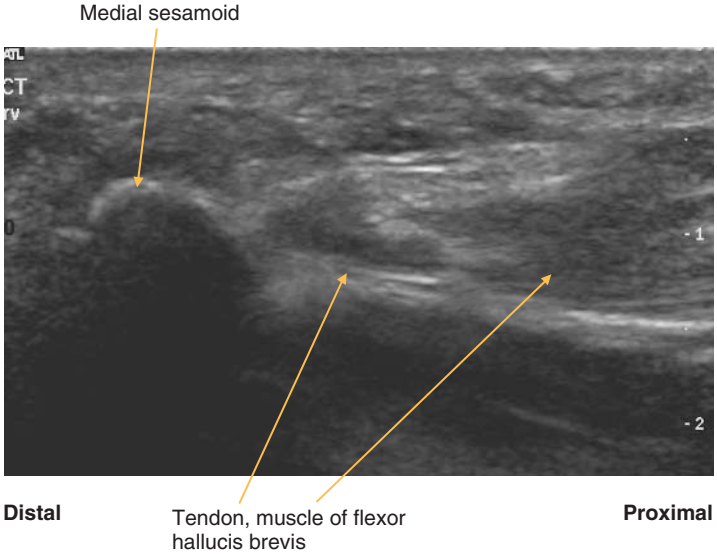

FIG. 307 LS, flexor hallucis brevis

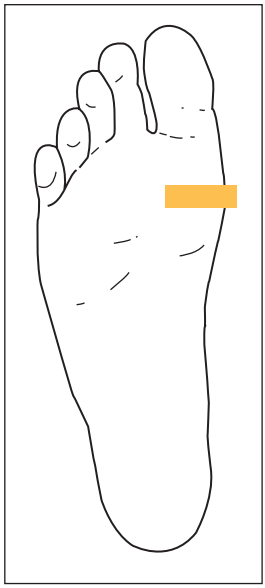

FIG. 308 TS, probe over sesamoids

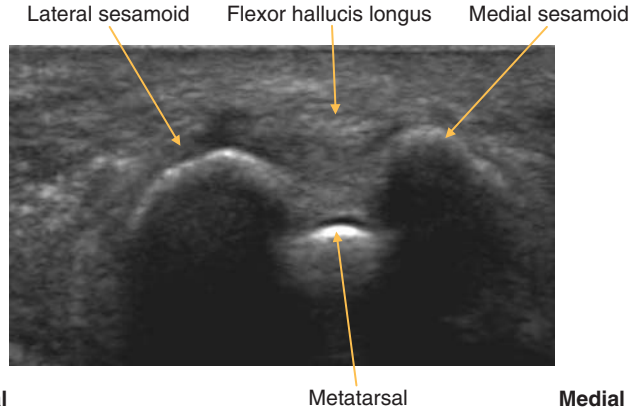

FIG. 309 TS, sesamoids

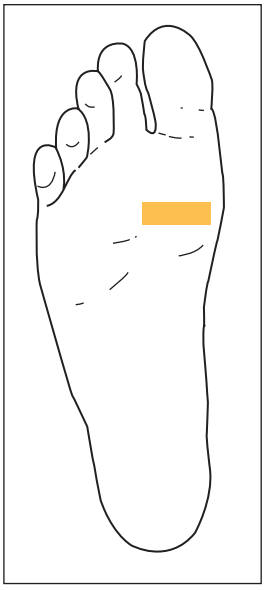

FIG. 310 TS, probe proximal to sesamoids

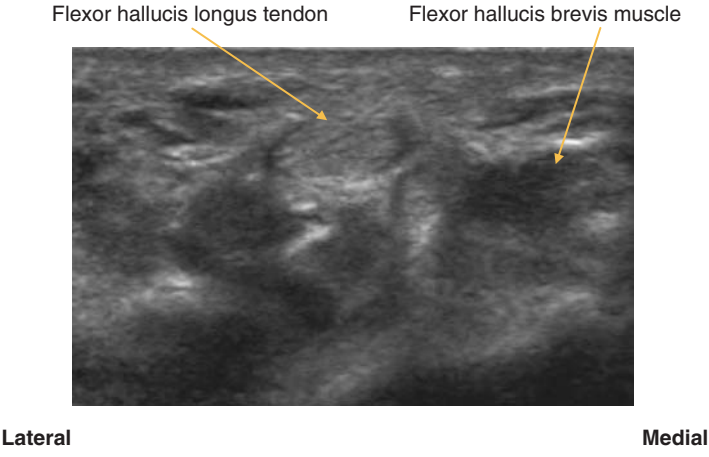

FIG. 311 TS, flexor hallucis – proximal to sesamoids

Plantar fascia

(Figures 312–315)

Three bundles – medial, lateral and middle.

Attaches proximally to the medial process of the calcaneum and fans into five slips to merge with the flexor digitorum sheaths to attach to the transverse intermetatarsal ligaments and the base the proximal phalanges. Strong septa pass from this fascia laterally to divide flexor digitorum from abductor digiti minimi, and medially from abductor hallucis.

Notes

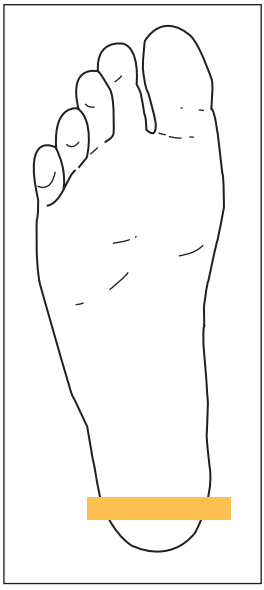

FIG. 312 TS, probe over heel pad

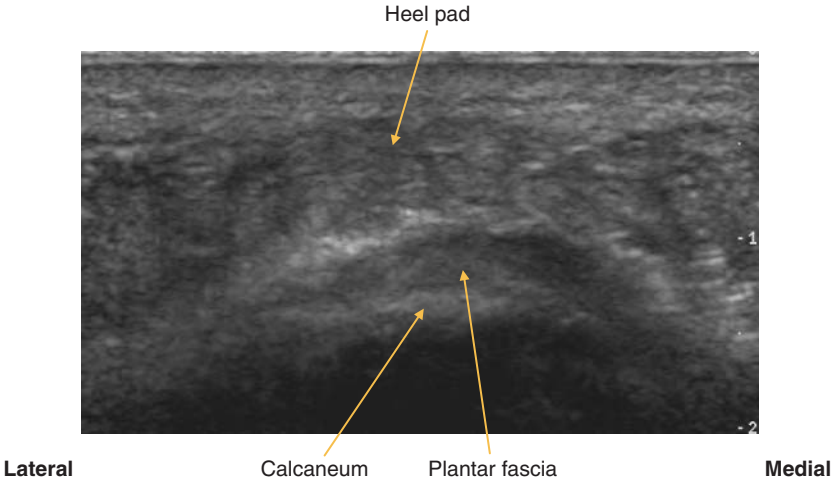

FIG. 313 TS, plantar fascia

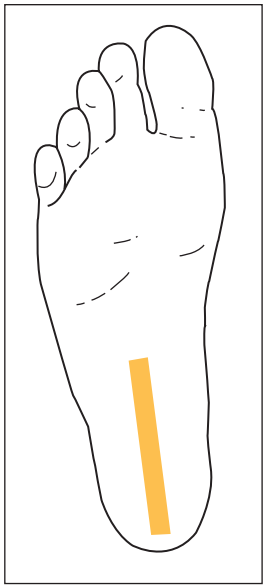

FIG. 314 LS, probe midline over plantar surface

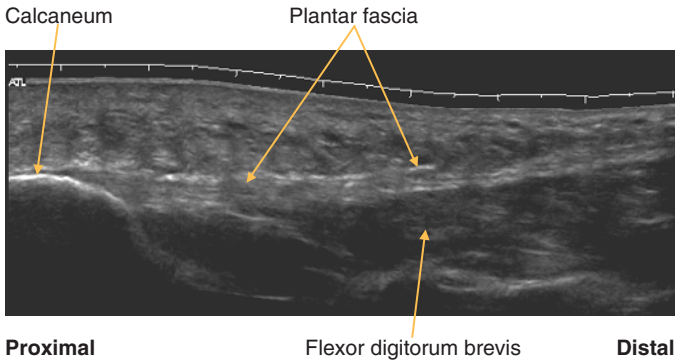

FIG. 315 LS panorama, plantar fascia

Plantar muscles mid-foot

(Figures 316 and 317)

There are four layers.

- Superficial: abductor hallucis, abductor digiti minimi, flexor digitorum brevis.
- Second layer: flexor digitorum longus, quadratus plantae, lumbricals, flexor hallucis longus.
- Third layer: flexor hallucis brevis, flexor digiti minimi, adductor hallucis transversus, adductor hallucis obliquus.
- Fourth layer: interossei, tendons of tibialis posterior and peroneus longus.

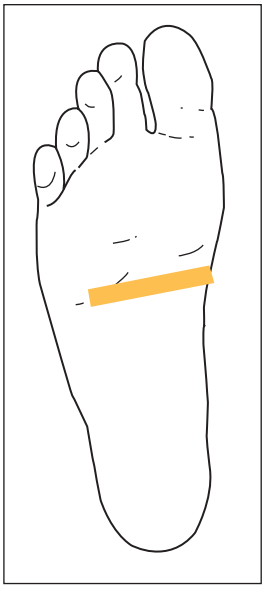

FIG. 316 TS, probe mid-foot

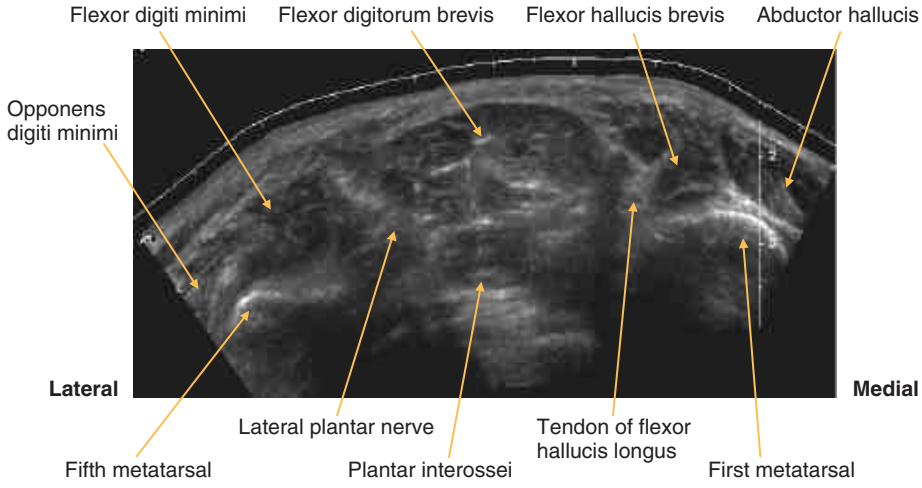

FIG. 317 TS panorama, plantar mid-foot

Dorsum of foot

(Figures 318 and 319)

Notes

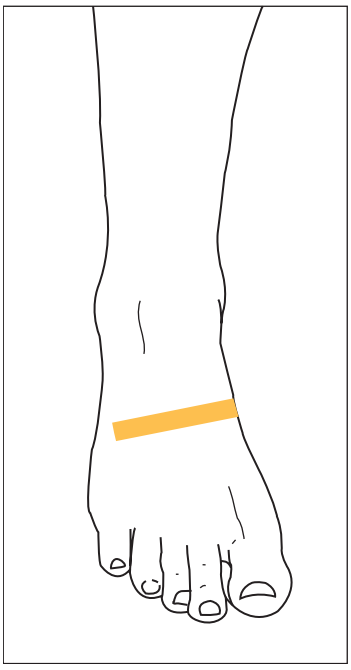

FIG. 318 TS, probe over mid-dorsum of foot

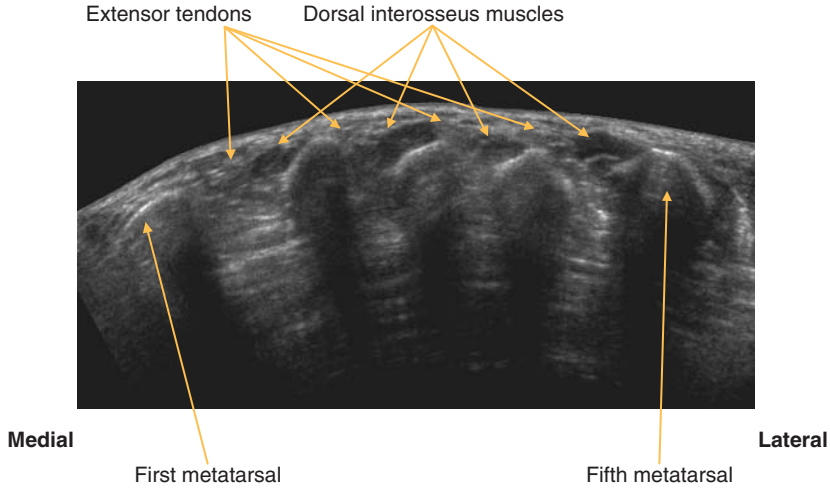

FIG. 319 TS panorama, dorsum foot

Extensor hallucis longus

(Figures 320–322)

- Origin: anterior surface of fibula, interosseous membrane.
- Insertion: passes distally to insert into the terminal phalanx of the great toe.

Notes

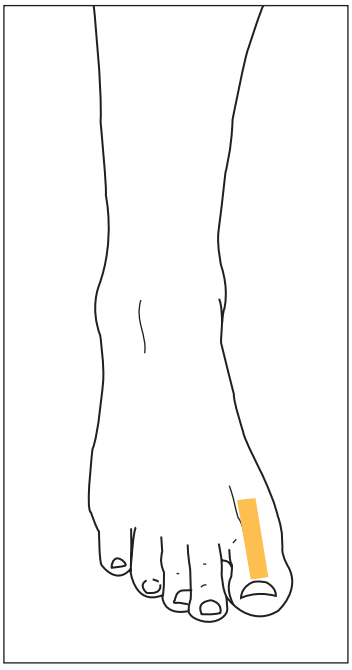

FIG. 320 LS, probe over dorsum great toe. Dynamic examination using flexion/extension of the great toe

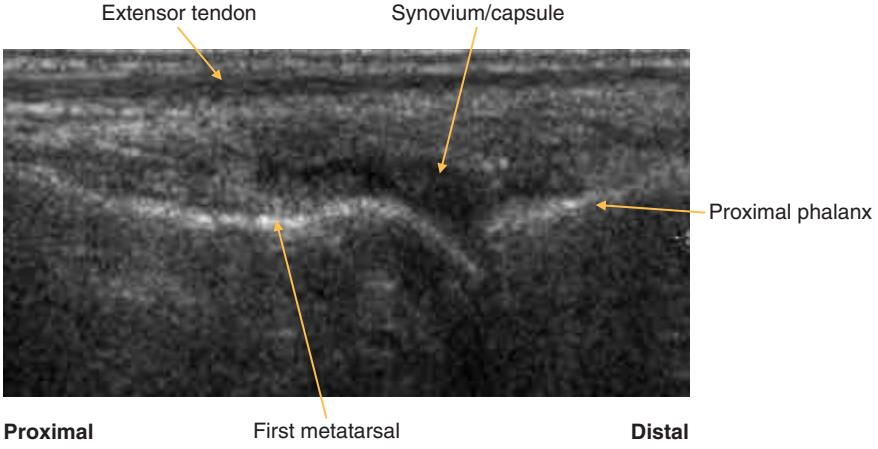

FIG. 321 LS, extensor great toe

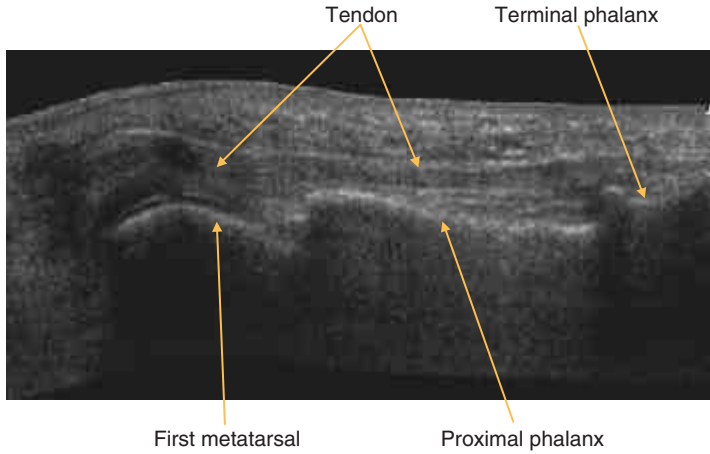

FIG. 322 LS panorama, extensor hallicus longus